ON THE BEST METHOD OF RAPIDLY CONSTRUCTING LONG TUNNELS.

BY G. BRIDEL.*

The facts from which the author draws his deductions relate principally to the Mont Cenis, St. Gothard, and Arlberg tunnels, a comparison being made between the modes of tunnelling adopted, divisible into two systems, viz., first, that of driving the advance-heading near the level of the roof of the intended tunnel; and secondly, where it is driven at the invert-level. The comparative merits of these two methods are reviewed, as regards speed of execution, suitability under various conditions and economy.

In the St. Gothard tunnel, where the first-mentioned or "crown-heading" (Belgian) system was adopted, the piercing was effected in much less time than in the case of the Mont Cenis, where the advance-heading was driven at the low level, or on what may be termed the "base-heading" (English) system. This advantage, however, was neutralized by the fact that after this stage had been attained the completion of the Mont Cenis tunnel was effected in nine months, as compared with twenty-two months in the case of the St. Gothard.

The author attributes this discrepancy to the facilities afforded by the "base-heading" system, in the subsequent excavation and transport, and the non-necessity for the frequent shifting of the temporary running-road and the air-conduits.

At the Arlberg tunnel, commenced about two years ago, the base-heading system has been adopted, with the result that although the rate of advance of the heading is 50 per cent. more than that attained at the St. Gothard, the completion of the tunnel section follows as close upon the heading as was the case at Mont Cenis.

The mode of procedure in this instance was to excavate a series of vertical shafts (about 3 chains apart) from the roof of the heading upward, until reaching the level of the crown of the intended arch; the upper portion of these shafts was then widened out, the excavation being shot, as through a funnel, into the wagons on the base-heading track.

On the 31st of December, 1881, the east heading of this tunnel had been driven for a distance of 2,031 yards, and the length of the finished tunnel was 1,170 yards, or 861 yards in arrear of the former. In July 1882, the lengths of completed tunnel and heading were 2,544 and 3,288 yards respectively, the difference being 744 yards, or 117 yards less than six months previously. At the west end the amount of arrear was slightly greater, due to the bad character of the ground traversed. This difference, however, is being lessened, and the base-heading system is considered to have been thoroughly successful.

A diagram showing the order in which the various portions of the tunnel area are excavated is given. The ventilation was effected by a special set of air-pipes (independent of their supplying the boring machinery) varying from 1 foot 3¾ inches to 1 foot 7¾ inches diameter in the finished portion of the tunnel, and reduced to 1 foot where the work was proceeding. The air was delivered at a pressure of 3 lbs. per square inch.

The base-heading system was adopted at the Mont Cenis, and at first worked in the same manner as the above described (Arlberg); but afterward the excavation from above the advance-heading was worked out in two cores, from the face instead of by shafts. This method necessitated the use of very strong timbering for the base heading (advance), but as the fissured nature of the rock would have made this requisite under any circumstances, no additional expense was entailed. Mention is made of the Laveno tunnel, where continuous base-and-crown headings, with occasional communicating-shafts, were pierced by mechanical boring throughout the length of the tunnel, the excavation being removed through the lower heading. The tunnel was 3,210 yards long, and was constructed in sixteen and a half months. This last method is recommended where the motive power sufficient for actuating the additional boring-machinery is obtainable.

The crown-heading system is then considered. The adoption of this system at the St. Gothard was principally due to the contractor, who, having his choice, preferred working on a system to which he had been accustomed. It was also hoped that with a crown-heading a better ventilation for the workmen would be procurable than had been the case in the Mont Cenis tunnel.

The advance-heading is followed by the removal of the excavation on each side, and as soon as springing-level is reached, the arch is constructed, and progressively underpinned with timber, permitting the erection of the side walls one at a time. The temporary way is first laid in the crown-heading, and as the various tiers of excavation below this are removed, the difference of level between each tier is surmounted by inclined planes of timber framing. Hydraulic elevators were introduced, but had to be abandoned on account of their being affected by the gases of the tunnel. A diagram shows the order in which the various cores of excavation are removed, and another compares the length of tunnelling under construction (Chantiers), at one and the same time, in the St. Gothard and the Arlberg tunnels. The distance from the completed portion to the heading of advance (crown-heading system) is in the former instance 3,007 yards, whereas in the Arlberg tunnel it is reduced to 1,258 yards.

A third diagram shows the progress of the excavation of the headings and the various cores, and of the masonry from end to end of the St. Gothard tunnel.

From this it is seen that the progress of the arch is irregular, and is accounted for by the desire on the part of the contractor to avoid expense, sought to be attained by shifting as seldom as possible the inclined planes connecting the tiers of excavation, stretching from the face of the advance heading to the formation-level at the finished tunnel. The author, after estimating the lengths occupied by the various processes of excavation, of blasting, and the inclined planes, etc., concludes that the normal length of tunnel under construction (Chantiers), at one and the same time, with this system, cannot be less than 2,586 yards, and that the crown-heading is not suitable for cases where mechanical boring is resorted to and expedition of importance.

The most suitable system to be adopted in passing through ground exerting great pressure is considered, whether by constructing the arch first and then the side walls, or the reverse. When the arch is constructed first, allowances should be made for its settlement, as, however carefully it may be underpinned, in ground of this character subsidence and an inward movement of the springing is almost certain to ensue as soon as the whole excavation of the tunnel section has been removed. An instance is mentioned where the allowance for settlement was as much as 3 feet 3 inches in the "windy stretch" of the St. Gothard, and of the difficulties encountered and distortions of the arching which occurred in the Foggia-Naples tunnel where the ground was of a plastic nature; the opinion being that under such circumstances the Belgian method of constructing the arch prior to the side walls should not be attempted.

The cost of excavation to the full section of a tunnel constructed by means of the crown heading, where the boring is done entirely by hand-labor, is 10 per cent. less than the same work where the base-heading is adopted; but when mechanical boring is resorted to, the saving in this item is reduced to 1.82 per cent. The cost of transport, however, is less with the base-heading system, and, as before mentioned, it is not necessary to shift the temporary track and the air-conduits, as is so frequently requisite in the crown-heading system; also the drainage is much better under control. A diagram shows the number of changes of the temporary track (including turn-outs and lie-byes), air-pipes, etc., on 1 kilometre of the St. Gothard tunnel during the term of construction (thirty-nine months). The percentage of the total number of men employed in connection with these latter items is 10 per cent., and this expense is reduced to comparatively nil where the base-heading system is adopted.

In the St. Gothard tunnel, up to the time of the junction of the north and south headings, the ventilation was very imperfect; air was supplied to the length under progress by piercing the pipes conveying air at a pressure of 90 lbs. (six atmospheres) to the boring machinery, but the motive power was insufficient to maintain a sufficient supply at that pressure, so that neither proper ventilation nor supply to the boring apparatus was attained.

The contractor for the Arlberg tunnel was paid

At the rate of	£79 17s. 7d.	per lineal yard.
Interest on plant supplied by the company	17 5 0	" "
	£97 2s. 7d.	

The contractor of the St. Gothard tunnel was paid

At the rate of £133 4s. 3d. per lineal yard.

The rock formation of the St. Gothard was harder than at the Arlberg.

In conclusion, the author is of opinion that for tunnels required to be executed with rapidity, the method of base-heading is preferable to crown-heading.

* From excerpt minutes of proceedings of the Society of Civil Engineers, England.

THE SANITARY CONDITION OF NASHVILLE.—Judge Allen of the Criminal Court lately delivered a special charge to the Grand Jury on the sanitary condition of the city, instructing them to make a thorough investigation, and present the corporation or owner in every case where premises were found to be in a filthy condition. Judge Allen said he was determined that the city should enforce her sanitary laws, and to compel every citizen to respect them.

THE DIAMOND FIELDS OF SOUTH AFRICA.

At the meeting of the Institution of Civil Engineers, held on the 8th of May, Mr. Brunlees, President, in the chair, the paper read was "On the Diamond Fields and Mines of South Africa," by Mr. James N. Paxman, Assoc. M. Inst. C. E.

The author commenced by stating that Kimberley was situated in Griqualand West, above 700 miles northeast from Table Bay, and 450 miles inland from Port Elizabeth and Natal on the east coast. Lines of railway were in course of construction from Table Bay and Port Elizabeth to Kimberley, and were about half completed. In Griqualand there were several diamond mines, the principal of which were Kimberley, De Beer's Du Toit's Pan, and Bultfontein.

In the Orange Free States there were also two mines, viz., Jagersfontein and Koffeyfontein, the first of which produced fine white stones. The mines were all divided into claims, the greatest number of which were to be found in the Du Toit's Pan mine. Bultfontein came next.

The deepest and most regularly worked was the Kimberley mine. The next deepest was De Beer's, which, however, was very unevenly worked. Then followed Du Toit's Pan and Bultfontein. The Du Toit's Pan mine ranked next in importance to Kimberley mine. Diamonds were first discovered in 1867 by Mr. O'Reilly, a trader and hunter, who visited a colonist named Van Niekirk, residing in Griqua. The first diamond, on being sent to the authorities, was valued at £500. Considerable excitement was caused throughout the colony, and the natives commenced to look for diamonds, and many were found, among which was one of 83¼ carats, valued at £15,000. In 1868 many enterprising colonists made their way up the Vaal River, and were successful in finding a good number of diamonds. The center of the river diggings on the Transvaal side was Klipdrift, and on the opposite side Pniel. In all there were fourteen river diggings. Du Toit's Pan and Bultfontein mines were discovered in 1870 at a distance of twenty-four miles from the river diggings. The diggers took possession of these places. Licenses were granted giving the first diggers a right to work. In 1871, De Beer's and Kimberley mines were discovered, and in 1872, Mr. Spalding's great diamond of 282½ carats was found at the river diggings.

The mines were of irregular shape, and were surrounded by reef. The top reef was a loose shale, and had given great trouble from the frequent slips. Below this were strata of trachytic breccia and augite; the formation was then seamy to an unknown depth.

Within the reef, the surface soil was red, and of a sandy nature. The next stratum was of a loose yellow gravelly lime, and the third blue, of a hard slatey nature. This last was the real diamantiferous soil. Large stones had been found in the "yellow," but the working of this generally did not pay. Kimberley mine, however, had paid very well all through. This method of working in deep ground was determined by roadways running north and south. The soil was hauled up to these roadways, and taken to the sorting-tables. The roadways decaying shortly after exposure to the atmosphere, a system of hand windlass was adopted, which worked very well for a time until horsewhims were introduced in 1873. The depth of the mines increasing, horsewhims had to give way to steam-engines in 1876.

The first diggers treated on an average ten loads per day each party. At the present time, the least taken out by any engine, when fully employed, was 250 loads per day. The cost of working, with present appliances, the first 100 ft. in depth, was 3s. 6d. per load; the second 100 ft. (mostly blue) 5s.; the third 100 ft. 8s., and the fourth 100 ft. 11s. Through scarcity of water, a system of dry-sorting had to be resorted to for several years; but it was superseded by the introduction of washing machinery, which was now generally employed.

At the commencement, through inexperience, many serious mistakes were made. When the first diggers reached the bottom of the red sand, they thought no diamonds would be found in the next stratum. When, however, diamonds were found in the second stratum, the diggers had again to remove the débris, and so also when the "blue" was reached. Some of the claims in the Du Toit's Pan and Bultfontein mines were irregular in shape. The other mines, however, had been properly and regularly laid out. One or two shafts had been connected with the mines by underground galleries. These galleries were convenient in the case of falls of reef. Labor at first was cheap; but from 20s. per month, wages rose to 30s. per week and food. The yellow soil offered no difficulty in working, being loose and broken, but the blue soil required blasting.

Several methods were adopted for extracting the soil and carrying it from the mine before steam was introduced. The cost of wood for heating purposes was a serious item, but good coal had now been found at 160 miles from Kimberley, costing £13 per ton; another serious item of ex-

pense was the transport over natural roads only, costing from £18 to £30 per ton.

The machinery designed by the author for this industry was described. A 16 horse-power direct-acting winding engine was introduced for hauling up loads at the rate of about 1,000 ft. per minute, and a 25 horse-power geared engine for hauling up heavier loads at the rate of from 600 ft. to 700 ft. per minute.

Water was dear, and water-heaters were fitted to each engine, by which 33 per cent. of the water was again used, thus saving one-third. The boilers were of the locomotive type, mostly of steel, to save weight, and thus reduce the cost of transit. The fire-boxes were also made of steel of very soft and ductile quality. A semi-portable engine was made for driving the wash-mill. The engine was so arranged that it might be removed from the boiler and placed separately. The boiler was made to work at a pressure of 140 lbs. per square inch. Automatic cut-off gear was fixed to each engine, and the governors were provided with a spiral spring for adjusting the speed. A screen, or cylinder wash-mill and elevator were used for dealing with the diamantiferous soil, and were described. Standing wires were fixed at the back of the machinery and passed over a frame fixed at the top of the mine, the end of the mine being secured to strong wooden posts. After the blue soil had been blasted and collected into trucks it was placed in tubs, which ascended the standing wires. It was then emptied into the depositing box. The yellow soil might be put into the wash-mill direct, also that portion of the blue which had passed through the screen fixed over the depositing box. The remainder of the blue, which was spread out to a thickness of 4 in. or 6 in. on the depositing ground some distance from the mine to dry, was delivered into the upper part of the screen. The return water from the elevator, with a portion of fresh water, was also discharged at this point, and operations were thus greatly facilitated, the soil becoming thoroughly saturated, and passing more easily down the chutes. The large pieces which would not drop through the meshes of the screen were discharged into trucks at the lower end and carried away. The smaller pieces with water, in the form of sludge, fell through into a chute, and thence were conveyed into the wash mill pan, and there kept in constant rotating motion by agitators. The diamonds and other pieces of high specific gravity sank to the deepest part of the pan, and the remainder of the sludge was forced over the inner ledge to the elevator. The sludge was then lifted and thrown upon an inclined screen and down the chute over the side of the bank. The residue left in the pan at the end of the day's work was passed through a pulsator, in which, by the force of water, the mud and lighter particles were carried away, leaving behind the diamonds, agates, garnets and other heavy stones. It was the practice occasionally to put a few inferior stones in the soil, to test the efficiency of the machinery.

In 1881 the author paid a visit to Kimberley, and found the industry a large one. The post-office return showed the value of diamonds passed through the office in one year to be £3,685,000. Illicit diamond traffic had hitherto been a source of great trouble at the fields. It was a question whether this industry would ever cease; in any case there was no doubt but that it would last for over a century. It was believed that the main bed of diamonds had not yet been reached, and that the mines in operation were merely shafts leading to it. Now that the water-works were finished, with a bountiful supply of water, coupled with the great boon of railways to the Fields, and the advantage of a law recently passed for the prevention of illicit buying, a great and prosperous future was in store for the Diamond Fields.

GAS FROM SEWAGE.

A syndicate is in course of formation in England to give practical effect to an invention which claims to settle the question of illumination, especially for domestic use, and the still more difficult one of the disposal of sewage. By a process which has been, or is about to be, patented, ordinary sewage, as obtained from an outfall sewer, is dried so as to be capable of being stored and conveyed in sacks. The drying is done on an inclined plane, and water that is not run off is evaporated by steam heat. The dried sewage, on being placed in a retort, yields a gas which burns with remarkable steadiness, and softness and brilliancy may be increased in the flame by adding gas from oil —say petroleum—in the proportion of one to every four cubic feet of sewage gas. The charcoal left after the sewage is exhausted of its gas is of a vegetable character, and this is said to form an excellent base for a manure, not unworthy to succeed the famous Peru guano, when the supply is finished up, as, according to some authorities, will soon be the case. In the manufacture of this sewage gas a variety of valuable by-products are formed. One of the advaniages claimed for this new illuminating agent is that it requires less pressure than coal gas in the delivery. The apparatus for its manufacture and supply may be identical with that in use for ordinary gas, with which indeed it can be mixed, with the alleged result of improving its quality. Thus it is not a rival to the lighting system in vogue as is electricity.

FIFTEENTH ANNUAL CONVENTION, AMERICAN SOCIETY OF CIVIL ENGINEERS.

Members of the Society and invited guests, including a large number of ladies, commenced reporting at the Leland House, the Chicago headquarters, on the morning of June 14. After a breakfast, rest of an hour or two, and some part at least of the dust and dirt of a thousand-mile journey had been removed, the entire party were invited to make an examination of the Chicago Cable Company, a special train of cars having been provided by the courteous managers of the company. This trip ended at the so-called "Stables," where steam, however, had supplanted the horse of olden times. The cable system, with its driving wheels and "compensators" for preserving a proper tension upon the traction cables, and the many ingenious details of "grip," etc., were duly explained, and questions enough asked and answered to satisfy even an inquisitive "Cape-Codder."

The next point of interest visited this same afternoon was the village of Pullman, owing its existence to the vast car manufacturing interests of the gentleman whose name it bears. This town is, without doubt, one of the most striking examples of rapid and perfect town-building to be found anywhere. Two short years ago its site was a piece of flat prairie land, to all intents and purposes a waste; to-day it is a small city; surrounding perhaps the most perfect and thoroughly organized system of shops in the country. The dwellings of the workmen are all built of brick, beautiful in their architectural features, well drained, furnished with water and gas, and having every sanitary detail carefully provided for; a theatre and lecture room, town hall and library, market building, stores of all kinds, and a hotel most elaborately furnished, cater to the wants of the people of Pullman and their visitors; everything in fact that the most approved modern engineering and sanitary science can suggest, backed by unlimited means, have been put into practice to make this a model town.

The only adverse criticism to be made on the afternoon's otherwise delightful experience was the lack of some of this same systematic work in the transportation of the visiting engineers from Chicago to Pullman; for some unexplained reason two and a half precious hours were consumed in traveling 12 miles by rail. This part of the programme was certainly not in keeping with the order and attention to detail otherwise everywhere so apparent.

The remaining three days in Chicago were devoted to the further exploration of this twelve-year-old city; for everything in the business portion of the place, at least, is dated from "since the fire." On Friday a number of the members went on a trip to the famous "Lake Crib;" another party investigated the elevators, by means of which the grain of the teeming fields of the far West is cleaned, handled and shipped to the Eastern markets. This last excursion had in it much of interest. The visitors had a practical illustration of how, at a total cost of 1¼ cents per bushel, the grain was cleaned, stored ten days, and then shipped aboard steamer or train, thanks to the many ingenious and labor-saving devices of American engineers. In contrast to this, one of the members present remarked that at Odessa, the grain shipping port of Russia, where the cargo was transferred in bags on the shoulders of men from the store-houses to the ships, it cost more to put it on board than the freight amounted to from Odessa to Liverpool.

The Exposition of Railway Appliances, just drawing to a close, was of course another center of attraction to the visitors; and well it repaid their examination, for as a class exhibit it was the most perfect and complete ever gathered under one roof in the United States. The array of locomotives, embracing as it did the very latest productions of the best builders, and the *first* engine of Geo. Stephenson, built in 1825, with several examples of somewhat later but still ancient types, was in itself worth a journey to see; for in no way could the wonderful advance in railroad progress be better exemplified. Side by side with the engine of to-day were other engines, as yet only suggestive, but very suggestive, of the near future; the Shaw locomotive, with its double outfit of cylinders, etc., and its wonderful speed record; the Wootten, designed to utilize the mountains of coal dust, now a waste product; another engine consuming petroleum as a fuel; and still another, in practical running order, in which electricity was the motor; all show that the end is not yet, but that progress is the order of the day.

Of the other exhibits, we can only say that they were fit examples of the world-famous productions of the busy brain and intelligent fingers of the American workman. Even a visit to the "Crank's Gallery," so called, was instructive, if only to illustrate the perseverance of the inventive class, and the undaunted manner in which a tailor or a cobbler will attempt to revolutionize railway affairs. The abiding faith of some of these misguided geniuses, in their ideas commands respect, though we quietly laugh at their offspring, as yet not advanced beyond the tin-and-pasteboard stage of existence.

"Cast Iron Files" is a rather startling announcement, and yet they were there, "warranted in all respects" as the equal of the old-fashioned article and very much cheaper; files sharpened by the "sand-blast" is another application of a long-known effect to the useful arts; steel castings, smooth and sharp, free from all imperfections, and often intricate in design, invite our attention; lap-welded iron tubes, 1¼ inches thick 10 inches in interior diameter, and intended for the conveyance of hydraulic pressure, are among the exhibits of the "National Tube Works," and excited our admiration; all manner of pumping engines; electrical appliances, for the safety of the traveling public, and electricity, as applied to lighting our dwellings and streets; machine tools, including steam hammers that obey the slightest touch; these are but a few of the many interesting objects that arrest the visitor at every step.

The men who suggested the Exposition and who so energetically and faithfully carried out the purposes of this great and invaluable educational enterprise are to be congratulated; and all the more so because the realization has exceeded their wildest dreams and fondest hopes, and in despite of a most lamentable want of interest shown by the local press of Chicago. It requires a personal visit to realize the success and magnitude of this exhibit; the majority of the newspapers of the city in which it was held, and in the material interest of which it was conceived, have been silent to a degree that demands explanation; very brief and unsatisfactory notices conveyed the news to the outside world. We have heard vague, and for the honor of the press, we trust unfounded, reasons for this silence, but whatever they were they can only be regretted. Sunday was devoted to rest, and the effort to keep cool in an atmosphere that would have been very hot even for New York. On Monday morning, at 7:30 "sharp," the members of the Society, lady friends and guests, to the number of about 240, boarded a special train—"the finest equipped and fastest that ever left Chicago"—to commence the journey to St. Paul. For the many pleasant memories that this trip must ever awaken, the American Society of Civil Engineers is indebted to the courteous management of the Chicago, Milwaukee & St. Paul R. R. Co. The usual time between Chicago and St. Paul is about 20 hours, and the distance 409 miles. This special schedule reduced that time to 13½ hours. The train was under the personal care of D. J. Whittemore, the Chief Engineer of 4,528 miles of track, and his able assistants, S. J. Collins, Supt. Chicago Div., W. G. Collins, Supt. of the La Crosse Div., and C. W. Case, Supt. of the River Div. Everything was done that could be done for the

personal comfort of the guests of the company, a most excellent dinner, and supper as well, was provided en route, and the hitherto unexampled railway feat performed of providing 500 single meals in one dining car, and providing them in such a manner that all were satisfied.

The success of this feat in catering was especially due to the system suggested and most strictly carried out by Capt. O. E. Michaelis, U. S. A., a member of the society, who was happily placed in charge of that portion of the committee of the day, whose necessary but rather irksome duty it was to "feed the hungry." Few of the participants in that memorable ride will ever forget the sharp military command of "time's up," and the polite but firm manner in which those who were showing a tendency to dally over the coffee were reminded that other famishing ones were to be provided for.

Of the succession of prairie land and thickly wooded hills, of the dales and lakes, and the ride of 200 miles aloug the banks of the "Father of Waters," that added so much to the enjoyment of all aboard, we can say but little; time forbids, and then we did not see them, as we were so unfortunate as to be on the "Feeding Committee," and were otherwise engaged.

St. Paul and then Minneapolis were reached and passed, and finally the train halted about midnight at the Hotel Lafayette, on the shores of Lake Minnetonka, the headquarters of the Society during convention week.

On Tuesday morning, June 19, the Fifteenth Annual Convention of the American Society of Civil Engineers was convened at the Minnesota State House, in the City of St. Paul; the members having been brought from Lake Minnetonka by a special train on the St. Paul, Minneapolis & Manitoba R. R.

In the absence of Chas. Payne, President of the Society, Director Geo. S. Greene, Jr., of New York, was nominated as temporary Chairman, and called the meeting to order; Gen. Bishop, Chairman of the St. Paul Reception Committee, made a brief address of welcome, and then introduced Governor Hubbard, who spoke as follows:

CIVIL ENGINEERS' CONVENTION—OPENING DAY—GOV. HUBBARD'S WELCOME.

GENTLEMEN OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS: It is with much pleasure that I greet you on this occasion and welcome you to this State. We appreciate highly the honor conferred by the presence in our midst of so distinguished a representation of your high profession, and we embrace with pleasure the opportunity afforded us of tendering to you the hospitalities of our people. It is our desire, gentlemen, to extend to you a welcome not to be measured by the feeble phrases in which it may be expressed, but rather one that shall cause each of you to feel, despite the distances you may have come, or the sacrifices of time and travel involved, that you are glad to be with us, and shall wish to extend your visit to the utmost possible limit.

Our entire country, and indeed, the interests of civilization throughout the world, recognize in the efforts and achievements of your profession a most important element of their progress and development. The great Northwest offers a spacious field and inviting opportunities for the exercise of engineering skill in the construction and operation of our railways, in the improvement and utilization of our water-ways, and in the development of many other of our national interests. We shall therefore hope to profit much scientifically as a result of your presence and deliberations here, as well as socially by friendly intercourse with you personally. As your host, we shall expect you to avail yourselves fully of the facilities afforded to make your visit pleasant, and we repeat a welcome which we believe you will realize is earnest and heartfelt before you will have bid us adieu. (Loud applause).

THE RESPONSE.

In response to the Governor's address, Col. Greene, the chairman, pro tem., said:

YOUR EXCELLENCY: In the necessary and unavoidable absence of our President, it has been allotted to me to make reply to the kind welcome which you have just spoken. In this common misfortune of his absence, I assure you, and all here, of my profound sympathy with you. When we were considering where to hold the convention of 1883 we were promised that if we would come to this, the commercial center of the Northwest and the geographical center of our great continent, we would be hospitably received and handsomely treated; but so far as we have gone, from our experience and from what we hear is prepared for us, we think that "not the half has been told us." (Applause). In behalf of this society, and for them, I beg to tender to you and to all those who are to assist you in receiving and entertaining us the most hearty and sincere thanks of the American Society of Civil Enginers. (Applause). Ladies and gentlemen, I now have the honor of presenting to you Mayor O'Brien of this city. (Applause).

On behalf of the city, Mayor O'Brien was received with applause, and addressed the assemblage substantially as follows:

LADIES AND GENTLEMEN OF THE SOCIETY OF CIVIL ENGINEERS: I have great pleasure indeed in welcoming you upon behalf of the city of St. Paul. The advent of your Society here is an occasion that fills us with the greatest pleasure, and I assure you we shall try to leave nothing undone to make your visit a welcome one, and a pleasant recollection to yourselves. It is peculiarly appropriate, to my mind, that your society should have selected this city and this State as the place for holding your convention, for indeed I think you will see around you evidences of the fact that it is to your profession that this State is indebted in great part, and our city almost altogether, for their present prosperity. By means of that magnificent enterprise the Northern Pacific road, inaugurated and carried almost to a successful termination by your profession, our frontier has been pressed northward almost to the limits of vegetation in the vicinity of the north pole. By reason of the application of your science to the waters of the Mississippi, the magnificent water tower at St. Anthony Falls has been preserved from its encroachment upon itself, and the forces of nature warring against each other, have been placed under tribute and control. And in our own city you have an opportunity of observing how the tangled pathway and ravines of the Indian, and the prehistoric man, have been so changed as to open avenues of commerce and of pleasure. You have touched the mountains and our bluffs, and they have crumbled away; you have laid your hands upon our rivers, and they have become the broad arteries of commerce and civilization. I could not make a set speech if I tried. It is hard talking in cold blood; but I honestly and sincerely feel that among the duties I have to fulfill toward the city of St. Paul, none gives me greater pleasure than to welcome you gentlemen. And I do so the more readily for, according to my recollection, about the last honest work I did myself was holding a level rod in a surveying party. [Laughter and applause.] And I have the additional but somewhat painful pleasure in saying, that in the eminent gentlemen who surround me here I can see the error of the choice of my early days, and from the appearance that the members of your society present and the work that you are doing, I can see how much better it would have been for me to have remained an honest engineer than to have become an unfortunate lawyer, winding up with the mayoralty of the city of St. Paul. [Laughter and applause.] But sometimes when we are most happy our feelings are best expressed in jest. That you have the best wishes of our citizens we will shortly advise you, I think, so that you will believe it. That you have our respect, and that your profession is entitled to the highest respect, no man can gainsay. A profession that commences its history in the United States with the honored name of Washington, and builds such monuments as that magnificent structure, the Brooklyn Bridge, needs no encomium from me or from any other speaker. Gentlemen, we thank you for your presence here; we thank you for the work which your profession has done for the State, and we expect that in the future the work of your profession here will be among us as lasting as those works which you have erected in other places in the country. [Applause.]

This closed the formal speeches of welcome.

THE PERMANENT CHAIRMAN.

Secretary Bogart stated that it had always been a rule of the society to select as permanent chairman a member of the society from the locality where the convention met, and in obedience to this custom he would, on behalf of the board of directors, nominate Mr. D. C. Shepard, of St. Paul, as the permanent chairman of the convention. Mr. Shepard was unanimously chosen, and on taking the chair addressed the convention as follows:

Gentlemen of the Society: I am at a loss fitly to express my appreciation of the honor bestowed upon me in selecting me as the presiding officer of your convention. Probably no assemblage has ever convened within the limits of our State whose members have exerted more influence upon the growth and development of our country than those of this society. The civil engineer of to-day is in fact the pioneer of civilization, and in this young and flourishing State, you will be able to contemplate some of the magnificent results of your handiwork. Begging the indulgence of the convention for my want of experience as a presiding officer, I now call the convention to order for the transaction of the regular business.

After the adjournment, the members of the Society rode out to Fort Snelling and Minnehaha Falls over the Milwaukee railroad. On arrival at Fort Snelling the party was received on behalf of Gen. Terry by Lieut. A. B. Johnson, of his staff; Lieut. Taber, the chief engineer of the department, and other officers, who pointed out the chief objects of interest. At Minnehaha a twenty-minute stop was made, enabling all to view this beautiful waterfall, of which so much had been heard. From there the train proceeded to the railroad bridge, built by C. Shaler Smith, on the short line across the Mississippi, which was examined by the members with interest. From there they proceeded to Minneapolis, and thence to the Hotel Lafayette at Lake Minnetonka. In the evening the entire party enjoyed a moonlight ride on Lake Minnetonka on board the steamer City of St. Louis, at the invitation of Gen W. D. Washburn.

THE BANQUET.

The complimentary banquet to the American Society of Civil Engineers by the citizens of Minneapolis and St. Paul, at the Lafayette Hotel, Minnetonka Beach, on the 23d, Friday evening, was an elegant affair, and the social event of the year. The distinguished party arrived at the hotel in sections, one coming by way of the Minneapolis & St. Louis road, thence across the lake on the steamer City of St. Louis, generously tendered by Congressman Washburn, and the other section made the trip over the Manitoba road. Although the banquet was announced at 8 o'clock, it was an hour and a half beyond that hour when the invitation was given to enter the banquet hall.

At 9:30 the party, numbering about 350 gentlemen, no ladies being present, were seated, and the next two hours were devoted to profitable discussion of a recherché menu, served in most excellent style by attendants.

AT THE HEAD OF THE TABLE

Were seated special guests of the evening. Hon. W. D. Washburn presided, and upon the right were Wm. Metcalf, a Director of the society, who represented the President in his absence; Hon. A. C. Rand of Minneapolis; Hon. William Lee, St. Paul; Hon. Henry W. Lore of Detroit, Mich., and Major C. F. Hatch of Minneapolis. Upon Gen. Washburn's left were seated Mr. John Bogart, Secretary of society, Jas. B. Francis, past President of the society, ex-Gov. W. R. Marshall, Congressman "Ben" Butterworth of Cincinnati, O., and Gen. J. W. Bishop of St. Paul.

At the three remaining tables were seated Speaker Fletcher of House of Representatives,

Hon. C. M. Loring, Hon. R. B. Langdon, Col. J. T. West, Thomas Lowry, Judge Koon, Judge Shaw, Hon. W. W. McNair, Postmaster Laraway, Hon. G. A. Brackett, and other prominent Minneapolitans; Mayor O'Brien, Judge Flandrau, Hon. Thomas Cochran, Jr., Gen. R. W. Johnson, Gen. Averill, Geo. R. Finch, Col. Crooks, John Farrington, D. W. Ingersoll, C. W. Hackett, George L. Farwell, E. W. Moon, H. S. Fairchild, A. K. Stone, Mr. Auerbach, A De Graff, C. A. De-Graff, and other prominent citizens of the capital city; Hon. Gordon E. Cole and other distinguished people from abroad, including the 300 engineers who have been in attendance upon the meetings. At the head of the hall was the only attempt at

ELABORATE FLORAL DISPLAY.

This took the form of a magnificent series of arches, being a fac-simile of the new stone viaduct at Minneapolis, to be used by the Union Railway Company. The length of the original is 2,600, but the fac-simile is only 40 feet long. The 23 arches and the bridge are formed in an artistic manner, nearly 20,000 choice cut flowers, mostly pinks, roses, pansies, bovadias and carnations, while a plentiful display of smilax was festooned about the base. The display was executed by Mr. W. C. Kilvington, from Hon. G. A. Brackett's private garden, and cost nearly $500.

POST-PRANDIAL.

At the close of the banquet President Washburn rapped the company to order and introduced the post-prandial exercises of the hour in a happy manner, referring in pleasant terms to the varied changes witnessed during his residence in Minneapolis, and paying a graceful tribute to the civil engineers for their part in making the glorious transformation. After some excellent music by the First Regiment band, which had been in attendance during the evening, Judge Flandrau, of St. Paul, and Hon. W. W. McNair, of Minneapolis, were introduced as representatives of the twin cities in officiating as toast-masters of the evening.

TOASTS

Were read and responded to as follows:

(1.) The American Civil Engineer; the pioneer and perfecter of our civilization. He marshals the forces of nature to conquer nature's obstacles.

Response by D. J. Whittemore, of Milwaukee.

(2.) The Engineer Corps of the United States Army. While its motto is simply to try, its practice is always to accomplish.

Response by William Metcalf, of Pittsburgh, in the absence of Major Farquhar.

(3.) Steam. That wonderful agent which has increased the power of man a hundred fold, solidified nations, brought continents together and introduced the remotest corners of the world into familiar intercourse.

Response by John Lawler, Prairie du Chien, Wis.

Mr. Lawler's speech was the gem of the evening, and was as follows:

MR. PRESIDENT AND GENTLEMEN: At the birth of steam the world wondered. The prophetic splendor of its achievements illumined all the boundaries of the universe. It was a giant, even in its cradle, and stretching forth its arm placed in the hand of man a sceptre of illimitable power. Few there were, at first, to grasp the stupendous meaning of this physical mystery. Here and there was found a Watt, or Stephenson, Fulton or Cooper, like a prophet by the wayside, whose genius enabled him to obscurely interpret its mission and to comprehend its marvelous potency in promoting the world's advancement. Hitherto, the oceans wed the continents, but by the intervening hand of time and space, divorced and made them strangers. Magnificent inland streams coursed the surface of the earth with prolific furrows of wealth and population; but beyond their marginal line, nature slept in solitude. Civilization is the mother of nations, and by a law of nature rocks the cradle of her first-born children by the shores of the sea. This law determined the seat of that mighty power that once rose above the banks of the Tiber, and made all the shores of the Mediterranean resplendent in the noonday light of its civilization. The same law fixed the destiny of that great modern power beyond the sea, on whose vast dominions the sun never sets. New York, the metropolitan center of our own country, that city of wealth, of fashion and beauty and power, encroaches upon the waves of the Atlantic, and lifts her masts and spires and all the monuments of her proud civilization in harmony with the same inflexible rule. Nature having chosen her favored centers of empire, steps aside that man may crown her choice by triumphs of his own. It was in accord with this latter law that New York was united the other day, in splendid nuptials, to her little sister, by the finest achievement of this age. Roebling and his co-workers directing by their genius the plighted hand of labor and of capital, reared a triumphal arch, consecrated to all the arts of peace, of imperishable renown. There it will stand through the ages more deserving the admiration of men than any that the conquests of the Cæsars ever flung across the Appian or the Aventide. There are periods when the life flowing currents of a nation almost cease to flow, and when nature seems to retire upon herself, to await to see what man himself can do. Never had nature less time to wait than in this our day, the age of steam, which is the grandest day that has ever dawned upon nature's view.

Steam is the supplement of nature. Steam begins where nature stops to rest. It draws distant shores together till they touch. It is the ambassador of both hemispheres. It makes co-partners of the nations. It draws the world together, and by the contact makes it better. It reveals the best side of humanity by making humanity acquainted with itself. The nearer we approach the more we trust. Its flag floats to-day above the keels of commerce, and friendship, faith and honesty are written on all the ledgers of the record. *Steam is the courage of capital.* It is the Neptune of the sea, and the Xerxes of earth. It storms the fury of the waves and pierces the rolling tempest of the clouds. Inspired by steam (I mean the volatile and not the fluid kind), there is no rock so high that capital does not climb; no river so deep that it does not swim; no valley so deep that it does not cross; no barrier so great that it does not leap; no triumph so grand that it does not achieve.

"Wait for the wagon and we'll all take a ride," was a popular song in our boyhood. The song of steam is now a national anthem. It is sung from ocean shore to ocean shore in cadences ascending to the poles. Steam has reversed the order of things and set the nation marching to quicker time. We no longer wait for the wagon. The locomotive, the noblest offspring of steam, the most efficacious of pioneers, following the torch of capital, precedes both the wagon and the plow. Solitude retires before it. Civilization and all her handmaids closely follow it. On all sides of its impetuous advance the industries spring up with a giant force. Capital thus inspired, enlarges all the fields of life, of art, science and labor. It builds monuments to human genius "that shall stand when those of Egypt fall." It puts sandals on the feet of science whereon science treads where she never trod before; it carries the child of labor from the cramped conditions of the "ancestral globe" and sets him down beneath some auspicious Western star, and leads him there to a home all his own, on soil as fertile as plow ever turned or the sun ever warmed. *Steam is the spirit of commerce.* It makes it. It lifts the burden from the shoulders of labor and makes man master of servitude. It puts the bread and meat of America on the table of wealth and the humble board of the poor on both sides of the sea. It has made the brand and the name of the millers of Minnesota a part of the world's alphabet. It presents the flour of Minneapolis for purchase and sale in all languages. Capital is now advancing its iron lines—lines converging here—on wings of steam, pushing outward their splendid circumference till it shall reach the waters of both oceans, sowing, as they expand, the seeds of national greatness and planting the germs of national prosperity, in which St. Paul and Minneapolis are destined to occupy a leading position. These two cities, St. Paul and Minneapolis, rivals in splendor, twins in prosperity, one in destiny, brightest gems of the valley, set on the crown of the Union by the peerless hand of a peerless civilization.

(4.) Commerce—The system that enables men to fulfill their highest terrestrial destiny, that of contributing to the happiness of each other.

Response by E. D. Meier, St. Louis.

(5.) Minnesota—While its enterprise furnishes a grand field for the labor of the engineer its lakes supply an elysium for his recreation.

Response by F. R. Delano.

(6.) Electricity—Formerly known as fire from heaven, it has now become a familiar companion by whose magic influence thought puts its girdle around the earth and darkness is banished.

Response by C. E. Emery of New York.

(7.) Beautiful Minnetonka, delightful Lafayette. We defy the whole association of engineers to produce a combination more conducive to happiness.

CONCLUDING CEREMONIES.

This concluded the regular exercises of the evening, but volunteer speeches were in order and the health of Congressman Washburn was proposed. He was warmly received, and referring to the magnificent floral display, gave a glowing tribute to Hon. Geo. A. Brackett, its designer, closing by presenting the display, in the name of Mr. Brackett, to Hon. J. J. Hill, President of the Manitoba road. Mr. Brackett was then called up and paid a glowing tribute to Mr. Hill.

Congressman Butterworth, of Cincinnati, was then introduced, and made a short speech, full of wit and eloquence, his sentiments being loudly applauded. Three cheers were then given for the "ought-to-be-Governor of Ohio," Ben. Butterworth, in response to a suggestion from a "voter in the second Ohio district."

After a few other speeches from Mayor O'Brien, Judge Flandrau, W. W. McNair, Judge Atwater and others, the company adjourned. Too much cannot be said of the magnificent manner in which the guests were entertained by the hotel, and the members and their friends were most lavish in their praises. The committee of arrangements consisted of J. W. Bishop, D. C. Shepherd and L. W. Rundlett, of St. Paul, and C. F. Hatch, W. D. Washburn and R. B. Langdon, of Minneapolis. The members of the press are under special obligations to Mr. Hatch for many kind attentions during the evening and for the courteous favors extended. The company took a special train at 2 o'clock, arriving in Minneapolis about 3, well pleased with the occasion.

[We are indebted for the above report from the Minnesota *Tribune* of the 24th.]

On Saturday, the closing day, a very large excursion party went to Stillwater, by rail to St. Paul, and thence by the Government steamer Barnard.

On the passage, Major McKenzie, Captain Durham and Lieut. Gillespie pointed out the many points of interest, explained the workings of the machinery attached to the boat for snagging purposes, and exhibited maps of the river and photographic views of many noted places between St. Louis and St. Paul. At noon a basket lunch was served in the main saloon, which had been prepared for the occasion by the Merchants' Hotel. Extra waiters had been provided by the boat officials, and the hunger and thirst of the party were more than satisfied. When the steamer came to the point where the Government fleet was anchored (of which the Barnard comprises a part), about four miles above Hastings, a halt was made to pick up Captain Hayes, of the U. S. steamer Ada B., who, being more familiar with the St. Croix River than Major Tipton, the Barnard's pilot, took the wheel after entering that stream. This was the only stop made on the trip. While passing through

the drawbridge at Hastings, the band played "The Prince of the Regiment," which attracted a large crowd to the banks of the stream, who cheered and waved hats and handkerchiefs as the steamer passed. After entering the St. Croix River, the band was summoned from the hurricane deck and assembled in the main saloon. Here waltzing was indulged in for half an hour, and then the lancers was substituted.

When the steamer arrived opposite Hudson the dancing was discontinued and the engineers went outside to view the bridge at this point. Considerable amusement was occasioned here by a man who, in endeavoring to show his expertness in riding a log, fell into the water, and when pulled out by his companions those on the boat waved their hats and cheered him.

The steamer arrived at Stillwater at 3.40 p. m., having been just four hours and fifty minutes in making the trip. At the dock the party were received by a committee of citizens, which consisted of the following persons: Mayor Matthews, D. S. Brown, Hon. Isaac Staples, Hon. John McKusick, Hon. R. F. Hersey, Judge McClure, Hon. J. G. Castle, Judge Murdock, S. R. Stinson, H. W. Cannon, R. H. Millard, E. L. Hospes, R. J. Wheeler, David Bronson, William G. Bronson, Louis Clark, city engineer; H. H. Harrison, superintendent of water-works; E. Nexsen, David Tozer and Matthew Clark.

The programme was to have made an excursion up the lake to the boom, but it being later than they had expected to arrive at Stillwater, this was abandoned, and the visitors proceeded direct to the opera-house. After all were seated the band played "One Day in Boston," which was loudly applauded.

Judge McClure then welcomed the visitors in a brief speech, in which he bade them a cordial and hearty welcome, and congratulated the city upon the fact that the distinguished visitors had deemed the city of Stillwater worthy of this passing call. He then referred in complimentary terms to the grand results of engineering skill in the Northwest. The engineer had bridged the rivers, cut down the hills, and made the land accessible to emigration. It was owing to the skill of the engineer that the great West was developed, and he was identified with all the great achievements of mechanical skill in the country. The judge referred to the grand structure, the Brooklyn Bridge, and said that though the name of Roebling might die, this structure would stand as an eternal monument to his greatness. The judge concluded his remarks by some facetious allusions to the fact that men could not subsist alone upon wood and stone and (pointing to the tables) invited the guests to participate in the good things set before them.

Before accepting the invitation, however, Mr. J. James R. Croes, treasurer of the society, responded to Judge McClure's welcome in the following appropriate language:

MR. CROES' SPEECH.

We thank you for your words and acts of welcome to the members of the American Society of Civil Engineers, who have come thousands of miles in every direction to interchange ideas and experience at this central point of our common heritage, and who have been met everywhere with a hospitality beyond our imagination, but not greater than we ought to have expected from the composition of the inhabitants of this magnificent region.

Communities in which several generations have been born, have lived and have passed away, inherit certain traditions and become sectional and narrow. But here the aggressive and progressive minds of all regions, forced away from their old homes by the feeling of narrowness, meet on common ground and vie with each other in the furthering of bold and novel enterprises.

It is most fitting, therefore, that we who represent the profession whose aim and object is to direct the forces of nature for the good of man, should assemble to learn what has been, what can be and what must be done to develop a great country, here at its heart where its great natural water ways begin their mighty course, conveying life-giving products on the one hand to the St. Lawrence and on the other to the Gulf of Mexico.

Some of us whose lives have been chiefly spent in the older sections of our land have been led to believe that water was held of little account in the Great West.

We supposed it to be used for culinary purposes and sometimes for washing. We knew that the creation of steam presupposed the use of water and that therefore even the railroads which bind the States together with links of steel require a certain amount of it.

But we find that after all it is water more than anything else which contributes to the development of this region, and the comfort and happiness of its residents. The beautiful lakes of your State are the paradise of the seeker for repose and health. The multitudinous small streams afford water for your live stock, and Wall street supplies water for your railroad stock. Your rivers afford the cheapest mode of conveyance to the market of the stores of timber, the procuring and manufacture of which is so immense an industry. The Father of Waters at the outset of his useful course is pressed into your service, and the greatest water power of the world is used to saw the lumber for a nation's houses and to grind the flour to feed their occupants. And it looks as if the reason why we find no blockheads here is because you grind them into sawdust and send them floating down the stream to be dispersed in the great ocean.

American civil engineering owes a great debt to water, for its obstructive and destructive characteristics have forced the engineer to the conception and execution of his greatest achievements in this great Northwest. It has compelled him to depart from the beaten track of precedent suggested by the lower animals and only developed by superior intelligence. The beaver builds above ground his dams of timber and earth, and men have followed his example, but it has been reserved for these later days for the engineer to arrest the destructive forces of nature by building, at the Falls of St. Anthony, a subterranean and submarine dam of masonry more enduring than the native rock.

The spider spun his web across a stream and made the first suspension bridge, and man has imitated him, but science and intellect have gone farther and, with what would be audacity, were it not the result of calculation and induction, built out piece by piece and bolt by bolt, airy structures, hundreds of feet above and across great gorges, until meeting, in mid air, the fragile looking "Short Line" bridge is able to carry the heaviest loads.

The drainage of the refuse water of a great Northwestern city, to perfect which it had been first necessary to lift the city up bodily, polluted its water supply, and the engineer daringly burrowed for miles in the clay under a great lake and reached a point beyond possibility of pollution. If, then, as we have been told many times during this delightful week, the Northwest is under obligations to the engineers, we cannot but feel that the engineer, in turn, is enormously indebted to the Northwest for opportunities of constructing great works, and the wise liberality which spares no money to accomplish its purpose.

This mutual dependence has wrought good results in other ways, and has done much to destroy faith out here in what an eminent historian and thinker has termed "the dogma, that if a man is only sufficiently ignorant his whims and notions constitute plain common sense."

You may think that I am inclined to "magnify mine office." It may be so, but I beg you to remember that 1800 years ago St. Paul did the same thing, and his descendants have not forgotten his example, and a week's association with them has borne its fruits.

Impressed with all that we have seen and all that we have heard, overwhelmed almost with the profuseness and heartiness of the hospitality we have met with, it is with extreme pleasure that we here conclude our round of excursions, discussions and festivities, and feel that while contact with winds and waves is invigorating, and constant alertness is inspiring, it is well for us to find ourselves at last, in Still-water.

After the speech making the visitors were escorted upon the stage by the committee on refreshments, consisting of G. M. Brush, A. K. Doe, D. H. Hersey, A. J. Jenks and W. A. Chambers. Three long tables were arranged across the stage and loaded with sandwiches, pickles, strawberries, cakes, wines, etc. All formality was laid aside, and everybody helped themselves, keeping time with spoon and fork with the music dispersed by the band. After the banquet the visitors proceeded to the depot and boarded the special train provided by the St. Paul & Duluth Railroad. As the train left the depot the citizens assembled at the depot, gave three cheers and a tiger, which was responded to from the cars. At White Bear the train was divided, those going to St. Paul taking the regular Duluth train, while those bound for Lafayette remained in the cars and went via Minneapolis. Before the final parting between the St. Paul engineers and the visitors, Secretary Bogart, of the Engineers' Society, mounted a trunk and proposed three cheers for General Bishop, of St. Paul, which was most heartily responded to. Gen. Bishop then mounted the trunk and bid the visitors farewell on behalf of the committee in a few well-chosen words. Mr. Richards, of Boston, then proposed three cheers for Col. Crooks, who has had charge of the excursions made by the party since their arrival in St. Paul. This was also enthusiastically responded to. A final hand-shaking followed and the Minnetonka train moved out, while the band played "Home, Sweet Home." The train with those coming to St. Paul pulled out soon after and arrived at 7:35 p. m. The party is now about broken up, many of them having already left for their respective homes. Some go to Duluth and return East via the Lakes. Others living in the South will go home via the river. Others intend to remain and spend a few weeks at Minnetonka and White Bear, and then make an extended trip throughout the West.

THE VALUE OF METALS.

Following are the names of those metals valued at over $1,000 an avoirdupois pound, the figures given representing the value per pound:

Vanadium—A white metal discovered in 1830, $10.000.

Rubidium—An alkaline metal, so-called from exhibiting dark red lines in the spectrum analysis, $9,070.

Zirconium—A metal obtained from the minerals zircon and hyacinth, in the form of a black powder, $7,200.

Lithium—An alkaline metal; the lightest metal known, $7,000.

Glucinum—A metal in the form of a grayish-black powder, $5,400.

Calcium—The metallic base of lime, $4,500.

Strontium—A malleable metal of a yellowish color, $4.200.

Terbium—Obtained from the mineral gadolinte, found in Sweden, $4,080.

Yttrium—Discovered in 1828, is of a grayish-black color, and its luster perfectly metallic, $4,080.

Erbium—A metal found associated with yttrium, $3.400.

Cerium—A metal of high specific gravity, a grayish-white color, and a lamellar texture, $3,400.

Didymium—A metal found associated with cerium, $3,200.

Ruthenium—Of a gray color, very hard and brittle; extracted from the ores of platinum, $2,400.

Rhodium—Of a white color and metallic luster, and extremely hard and brittle. It requires the strongest heat that can be produced by a wind furnace for its fusion, $2,300.

Niobium—Previously named columbium, first discovered in an ore found at New London, Conn., $2,300.

Barium—The metallic base of baryta, $1,800.

Palladium—A metal discovered in 1803, and found in very small grains, of a steel-gray color and fibrous structure, $1,400.

Osmium—A brittle, gray-colored metal, found with platinum, $1,300.

Iridium—Found native as an alloy with osmium in lead-gray scales, and is the heaviest of known substances, $1,090.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
Tribune Building, New York City.

The Engineering News Publishing Company, Proprietor.

Published Every Saturday.

CONDUCTED BY
GEO. H. FROST and D. McN. STAUFFER.

TERMS OF SUBSCRIPTION:
$4.00.....PER YEAR TO U. S. AND CANADA.
$5.00 ..... " " " FOREIGN COUNTRIES.
Make all drafts and cheques payable to ENGINEERING NEW PUBLISHING CO. Postal Money Orders, for convenience, may be made payable to GEO. H. FROST.

THE Belgian contractors have now a sort of Commercial Museum that, it is said, furnishes them with some very useful information. An English paper, The *Contract Journal*, also advises the formation of such an institution in England, although it is acknowledged that many contractors would be opposed to it. The immense distances in the United States would practically prevent any single institution from fulfilling any beneficial purpose in such a line.

THE San Francisco *Bulletin* has recently made serious charges of abuses in the public surveys. Since 1879 the expenses have increased from $300,000 to $500,000, to seven times the latter amount. The complaints refer to a certain bureau operating in California, Nevada, Wyoming, Idaho, Montana and Nebraska. The *Bulletin* states the expenses of the surveying service now range from $100,000 to $200,000 a month, and that nearly the whole amount is caused by "special deposit" work. The *Chronicle* mentions this statement, but gives no opinion on the subject.

IF M. DE LESSEPS has his way and all his plans succeed, there will be no doubt that French engineers, especially those of the Ecole Centrale, will acquire a reputation for their connection with works of peculiar engineering difficulties. At least this is the opinion of M. F. DE LESSEPS, and in a recent lecture before the pupils of the Ecole Centrale he gave his ideas with regard to the great enterprises that his father and himself are actively pushing. A second Suez Canal must be built, but by the present company All the surveys for the interior African sea are here completed. This sea is, however, very different from the Sahara project, and the quantity of matter to be excavated for the channel from the Mediterranean to the Rharsa *chott* is fixed at 200,000,000 cubic meters, the cost of which is estimated at $20,000,000. The Panama Canal would form the crowning work of French engineering and capital.

HOWEVER difficult it may be to prevent flooding along great distances, there certainly ought not to be any insuperable obstacle in preserving cities from inundations. A plan is now under favorable consideration by the communes round Paris which seems to offer a simple and efficacious method of escaping floods. The Marne in times of freshet has a body of water equal to that of the Seine, and the plan proposes to cut a canal that will serve as an overflow to it. At the same time the Seine would be relieved of half its volume from Carrières—Charenton to Epinay-les-Saint Denis—the Marne would be relieved from Neuilly-Plaisance. The canal would be 18 kilometers in length and from 7 to 28 meters in depth. Besides securing some twelve communes from inundation, the canal would shorten the distance for boats by some 29 kilometers.

Some new waterways might be advantageously built by deflecting a portion of the over-abundant waters of our great rivers. The surrounding country might be benefited by new means of transport, and even a considerable proportion of the water might be made use of for irrigation, etc., thus permanently withdrawing so much from the excess. Of course such a system would not be applicable everywhere.

THE manufacturers of the United States are endeavoring to form some more definite idea as to the probable scope of the American trade, not only with regard to domestic, but also to foreign requirements. The great cry for years has been export trade; the greatest prosperity of the country has been under an almost altogether domestic trade. It is probable that the expectations of those who look for great results in shipping American manufactured products abroad will never be more than partially realized, and for general and special reasons. America is a country different from all others; an isolated political autonomy, so to speak, having distinct aims and requirements, and possessing unusual and varied resources. It cannot safely imitate the older countries, but must necessarily mark out a pathway for itself. Its greatest victory will be to establish new systems, new principles of government, law, and political economy, which will enable the nations of the world to take a fresh start. The purpose which the United States will subserve in the world's political economy is far-reaching. The people are seemingly the blind instruments for the accomplishment of grand results. A higher manhood will be developed here; despotisms and narrowness of all kinds will find their death in influences and agencies which will have their birth in this land. The pilgrims started the historic revolution by seeking retigious liberty, the men of the revolution carried it on by seeking political independence, and the innate energies of the American people have ever since been driving the contest to its utmost limits. If we were to ask any American, "What is the ulterior purpose of your struggles and efforts; what is the object at which the Government of the United States is aiming; what are the principles which you seek to make fundamental and ineradicable?" he would be unable to answer; he does not know. The American people have, to use a figure of speech, the irdestiny in their own hands, but they do not know what it is. They do not comprehend whither it is leading them.

The American people and nation are not merely maintaining political independence; not merely building railroads, cultivating fields, digging gold, coal and stone; not simply building hamlets, towns and cities, and erecting palaces which rival in magnificence those of olden times. But they are doing a grander work; they are working out grander problems, though they do not know it. They are making possible things which one hundred years ago were impossible. They are hewing out a new pathway through which other peoples and nations must follow; they are building roads over which others must walk. They are erecting guide-boards by which the nations of the world must march in their progress toward a higher civilization. The American people are doing more. They are rendering it impossible for injustice to endure much longer, or to barricade itself (behind) arms, legislation or wealth; they are weakening the chains which bind the millions in political and industrial subjection, and are opening up avenues of escape from the bonds which have for centuries held them captive. All this they are quietly doing; eliminating wrong, arresting evil, developing the good in human nature, uncovering its hidden divinity, and making manhood proud of its achievments and hopeful of still further victories in its chosen pathway. They who delve in shop and laboratory, and office and mill, working out the practical details of our great civilization, do not fully comprehend the vastness of the revolution which we are entering nor the vastness of the work which we are to achieve. We toil on, delve on, figure and calculate, while the nation of workers follow in our lead, do their prescribed work, and create wealth with a rapidity never known of or possible before. Only fifty years ago steam locomotion came to our aid to multiply and expand our forces; it was only yesterday that we heard of electric energy, and it is yet too soon to say what this infant giant may have in store for us. Those who see farthest into nature's arcana are bewildered with the multitude of possible and probable agencies which can be developed and chained into the service of man. Our progress, though vast, is far from having reached an end. American institutions, born out of centuries of revolution, are not yet perfect. Bad influences, bad laws, and bad economical and political conditions in Europe for half a dozen centuries have prevented the normal development of man, and have distorted his being. America is the great vent for the wrongs and evils inflicted by the despotisms of other lands. The "isms" which shake Europe are but a tempest in a teapot as long as American opportunities remain to invite the overcrowded millions. The engineers of to-day build bridges and railroads, and delve into the bowels of the earth for minerals for the comfort and convenience of man, but the great engineers of the future are those who will evolve from the competing forces in existing conditions such relations and laws, and, in fact, such institutions as will allow the rapidly developing energies of the nineteenth century to crystalize their efforts into perfect results as far in advance of those of to-day as those of to-day are in advance of the day when George Stephenson opened the throttle-valve of the Rocket.

THE MASTER PLUMBERS IN CONVENTION.

Alas, the poor Sanitary Engineer. Like the Chinaman, the decree has gone forth that he must go! The diamond-fronted plumber has risen in his indignation and declared that he, the plumbers' greatest foe, must be fought without gloves, and no quarter shown, and if so, how can our poor professional brother hope to contend against his brawny antagonist?

The Master Plumbers of the United States held their first national convention June 27, at the Masonic Hall, in this city, which was attended by about 200 delegates from different parts of the country.

The chief purpose of the convention was to take measures to prevent manufacturing jobbers selling materials to the consumer direct, instead of to the trade.

At 10 o'clock Plumber Abram Meade of this city delivered an address of welcome. To him it was a beautiful sight to see plumbers dwelling in unity. Then the plumbers began to lay pipes for the election of permanent officers.

Plumber Enoch Remick read the address, of which the most striking pas sages were these:

It is a general feeling among plumbers that our legitimate trade is filched away from us by unscrupulous dealers. We are held up to the public gaze as ignorant and reckless individuals, who tamper with the lives and the health of our customers. A newly invented profession called sanitary engineering has come to light. It proposes to protect humanity against its insidious enemy the plumber. Boards of Health, too, lend their aid to these magniloquent braggarts, by frowning upon our practical skill and experience, and indorsing book-taught experts and newspaper scientists. It is a fact that the men whose pursuits lie closer to the sanitary problems of the day than any other are ostentatiously ignored, and the claims of raw graduates from medical or other schools are brazenly thrust in the faces of the public.

The old-time steady and conservative plumber seems to have lost caste, and the way has been paved for the advent of a new excrescence in the body politic. Is it necessary to mention the so-called sanitary engineer or expert? The occupation just mentioned seems to have originated in the fertile brains of those enterprising geniuses who always see in a popular panic the means of riding to fame and fortune on the fears and prejudices of a gullible public. The experience and skill attained only after many years is derided and sneered at, while the glib-tongued and smooth-phrased expert, stocked with the latest catch words of sanitary science, is eagerly sought for, and his opinions accepted as implicitly as the oracle of the ancients. Popular prejudices are pandered to, and the unlucky plumber is relegated to the humble position of mere fitter up of whatever fantastic ideas or notions have been evolved from the brain of the sanitary expert.

Plumbers are placed under the jurisdiction of persons whose knowledge is derived from a course of lectures in a popular college, or whose claims to office are backed up by influential politicians.

Now let us have the bricklayer rise in his might, and declare war against the "book-learned" architect, who knows nothing practically of the "noble art" of laying a brick in a wall—and perhaps of carrying one in his hat.

J. B. HARRIS, who recently resigned his position as Superintendent of Construction of the Oregon & California Railroad, sailed on the 15th inst. for Central America, to take charge of all the railroad construction work under the Stanford-Crocker-Huntington combination.

PERSONAL.

CIVIL ENGINEER R. E. PERRY has been ordered from duty at Key West and from the Navy-Yard, Washington, and placed on waiting orders.

HENRY R. WORTHINGTON has opened a branch office and warehouse at Chicago (95 Lake st.), with a full stock of the Worthington Steam Pumps.

LIEUT. DAN'L C. KINGMAN will be relieved from duty as engineer officer, Department of the Platte, and will report to commanding officer of the batallion of Engineers, Willett's Point, N. Y., for duty.

PROF. STEPHEN ALEXANDER, LL.D., Professor of Astronomy at Princeton College, died on Tuesday. He was born at Schenectady, N. Y., Sept. 1, 1806. He was the author of numerous works on astronomical and mathematical subjects.

CAPT. W. H. BIXBY of the Corps of Engineers will be relieved from duty with the batallion of Engineers at Willett's Point, N. Y., and will take station at New York City, and complete preparation of his report upon his investigations in Europe in 1881–82.

FIRST-LIEUT. JOHN MILLIS will be relieved from duty with the batallion of Engineers, and on completion of his duties as recorder of the Board of Officers will report to the commanding general Department of the Platte, for duty as engineer officer of that department.

SECOND-LIEUTS. GRAHAM D. FITCH, 5th Artillery, and EUGENE J. SPENCER, 4th Cavalry, are to rank as Second Lieutenants in the Corps of Engineers from July 1, 1882. The latter officer will proceed from Fort Bayard, New Mexico, and report at Willett's Point to commanding officer of the Engineer Battalion.

GEN. SIR. EDWARD SABINE, K. C. B., F. R. S., died recently in London. He took part in the war of 1812-14 on the Niagara frontier, commanding the batteries at the siege of Fort Erie. He was first brought to the notice of the public by the part he took in the explorations of Ross and PARRY in 1819. His magnetic observations while on these expeditions gave a great impulse to the study of terrestial phenomena. In 1821 he began a series of voyages, ranging from the equator to the arctic circle, and published the results of his observations under the title of "The Pendulum and Other Experiments." He made many valuable reports and wrote numerous papers on scientific subjects, and was identified with the Royal Society from 1830, being elected its President in 1861.

CORRESPONDENCE.

NORWICH, Conn., June 25, 1883.

EDITOR ENGINEERING NEWS:

Will you, or some of your readers, inform me as to what guides experience has given as to the size, form, material and best manner of laying subsoil drains in connection with sewers?

Should they be laid underneath or alongside the sewer, and in either case, is there any practical difficulty in so backfilling as to form a good foundation for the sewer? Is it practicable generally to use them in draining a wet trench during the construction of the sewer? Is there anything on the subject in print?

Respectfully, C.

ANDOVER, N. J., June 20, 1883.

EDITOR ENGINEERING NEWS:

I would like to ask a few questions.

When a rail turns upon the ties, or what they call rolls, and the ties are not cut by the rail flange and wheels run on the side of rail, what is the cause—imperfect rail?

On a curve, if it is the fault of the rail, can it be put on the other side of curve?

Are any roads laying paper ties this season?

Should ties be placed on the ends to dry or season?

Should entirely green ties be laid?

What is the greatest deflection a steel rail will bear before breaking (lateral bend)?

Are there any steel or iron rails rolled and in use, length 60, 100 and 120 ft.?

In setting fence posts, is there any truth in the statement that they must be peeled and placed small end down in ground?

What is the theory of a hewn tree lasting longer than a sawed one? Respectfully,

A. STIFF, Section Boss, Sussex R. R.

QUICK TIME IN LEVELING.

SHIRLEY, Me., June 25, 1883.

TO THE EDITOR ENGINEERING NEWS:

Having noticed the letter from "J. M. R., Jr.," in your issue of June 16, in relation to "Time in Leveling," it certainly does appear extraordinary, being less than two minutes to set up instrument, take sights and move to next point. If there is no misprint or mistake in the matter, we are all willing to "lie down." We are now at work in a rough country, but have no such rise to overcome as that spoken of, but still should consider the distance of one mile and a quarter a very satisfactory day's work on test levels. Yours truly,

ENGINEER'S PARTY, B. & P. R. R. Extension.

ABSTRACT OF PAPERS READ AT THE ST. PAUL'S CONVENTION, JUNE 22.

RAILWAY REPAIRS.

Mr. Benjamin Reese of Toledo, Ohio, Division Engineer of the Lake Shore & Michigan Southern road, presented a paper upon railway track repairs, of which the following is a synopsis:

A very important branch of the labor upon our railroads are the section forces and their organization for the proper maintenance of the track. It often occurs that too little attention is paid to the direction of the details of this labor, which is in too many cases left to the entire direction of the track supervisor men, who though well trained by years of practice and experience, too seldom have the necessary knowledge for the proper application of theory to practice. The methods of these men are also the proper objects of direction, as to where cuts should be made, in pinching economic ties so as to derive the best results, sometimes with inadequate means for the complete and satisfactory maintenance of way. One item of frequent waste is in the changing of ties with too little regard for their condition at the time of removal. My practice is to have all old ties piled neatly, to remain until the same have been examined, and the judgment of the section foreman trained as to what should come out and what should remain. A tendency exists among foremen to take out a run of ties simply for the greater ease of replacing them, it being much easier to place three or four ties in succession than to distribute that number just where needed; as a result the portion of the track last gone over frequently suffers from the lavish use of ties in the work of the early season. From the improper tamping of ties comes many of the "ills to which track is heir to," and great care should be taken that each tie is thoroughly tamped. Much track that looks smooth on the surface of the rail is shown to be very uneven under a running train, the spike holding the tie to the rail. This condition lasts but a short time, as the continual spring of the rail draws the spike from the tie, and the process of cutting by the flange, so destructive to ties, begins. It is important to instruct the section foreman in all details of work, and great results will be seen, both in condition and economy of cost. The matter of attention as to a line gange, organization and system of reports were touched upon by the speaker.

STANDARD TIME.

Dr. Egleston, from the special committee on standard time, appointed at the meeting of the society held in New York in January last, made a report to the effect that the committee had obtained a general expression of opinion from men prominent as engineers, railway managers and operators, and others, in all parts of the United States and Canada, and found that exceptional unanimity prevailed with respect to the fundamental principle which should govern in the adoption of a system of standard time for the whole country; and the present meeting of the society, in the great upper valley of the Mississippi, seemed to be a peculiarly appropriate occasion for directing attention to the benefits to result from a comprehensive time system, based on the principles which commended themselves to approval so general. In attending this convention, many of the members must have experienced that the railways over which they traveled, within a limited distance of this city, are run by three different standards, viz.: Chicago time, St. Louis time and St. Paul time. These various local times lead to various inconveniences which would be entirely obviated by a unification of standards. If a compromise could be effected by the railway authorities, and they were to adopt a mean between the times of Chicago, St. Louis and St. Paul as a common standard for all the railways in this part of the United States, great convenience would undoubtedly result. The managers of the transcontinental railways, who have been heard from, cordially sustain the system of standards which have been suggested, and have agreed to adopt them in the running of trains. In conclusion, the committee say that the time is near at hand, if it has not actually arrived, when definite action should be taken by legislation, or otherwise, to establish a system of standard time for general use throughout the country. The governing meridians proposed are each to be an integral number of hours from the prime meridian of the world. The report was accepted and the committee continued.

PONTOONS.*

The railway pile pontoon bridge, which is the subject of this paper, was built in the year 1874 across the Mississippi River, between Prairie du Chien in the State of Wisconsin, and North McGregor in the State of Iowa, for the purpose of connecting the divisions of the Chicago, Milwaukee & St. Paul Railway Company terminating respectively at the points named. The river here is divided by an interjacent island into two channels, both of which are navigated. The McGregor channel, so-called, is 1,500 feet wide at a medium stage of water, and the Prairie du Chien channel is 2,000 feet in width. The distance between the Wisconsin and Iowa shores, embracing the island to which reference has been made, is 7,000 feet, which corresponds to the length of the bridge. The structure throughout is of ordinary piling, except the navigable portions of the channels, which are covered by the pontoon draws. Each of these draws is a single float thirty-six feet wide at the bottom, six feet deep, forty-one feet wide on deck, and 408 feet in length. The frame and bottom of the draw is of Norway pine of heavy dimensions, and the deck of white pine. Each draw has five heavy bulkheads running the whole length, which are thoroughly bolted through and through. The track is regulated to the varying levels of the river by a system of blocking, confined in frames and adjusted by means of hydraulic jacks. It may be observed that the range of variation between high and low water is twenty-two feet. There is used in the construction of each draw about 600,000 feet of plank and timber The draw is operated by a steam engine of twenty horse-power, which communicates motion to a pulley chain passing over a drum and stretching along the bed of the river to suitable points above and below the draw, where it is properly fastened. The pontoon, when closed, is held in position by a T-shaped wrought-iron shaft five inches in diameter, and which projects over the side of the draw into a timber frame faced with iron and secured by a pier driven around it. This coupling or fastening is so arranged that it may be instantly attached or detached by a single person. The draw, when in position for the pas-

* Abstract of paper read by Gen. John Lawler, of Prairie du Chien, at the St. Paul Convention.

sage of trains, lies across the current of the stream at about a right angle, and when opened for the passage of the river craft comes to a rest parallel to the current. The time occupied in opening or closing the draw is three minutes. At each end of the draw shear booms rest on piers driven for the purpose, and extend at an easy angle to either shore, by means of which the largest rafts are safely guided through the draw opening without the necessity of uncoupling. The structure was built at about one-sixth of the estimated cost of the ordinary pivot bridge. A bridge of a similar style was erected last year across the Mississippi, between Wabasha, Minn., and a point in Wisconsin near the mouth of the Chippewa River, and Congress has authorized the building of several others at various places on the Upper Mississippi. In conclusion, I desire to express my sense of gratitude to D. J. Whittemore, Esq., chief engineer of the Chicago, Milwaukee & St. Paul Railway Company, for his valuable assistance while the bridge was being planned and built. To him I am also primarily indebted for the introduction that prefaced my admission into this society, which enables me to participate in the advantages and pleasure of this occasion.

INDORSEMENT.

Mr. Lawler's paper was greeted with applause, and at its conclusion Mr. W. P. Shinn, of New York, said he had occasion some two years ago to be in Prairie du Chien, and had ample time to examine the bridge. It happened to be a season of high water, and he was astonished at the ease with which it accommodated itself to the rise and fall of water. To Mr. Lawler are we indebted for this new method of carrying heavy trains of cars across rivers. Mr. D. J. Whittemore, while properly thankful to Mr. Lawler for his kind allusion to him, at the same time disclaimed any merit in the matter. The merit and invention belonged to Mr. Lawler alone. Mr. Whittemore then gave an account of a somewhat similar method of spanning rivers with floating bridges, which was in use as early as 1851, and which remained in use until 1868. A railroad company desired to build a bridge across a narrow space in Lake Champlain, but the State of New York refused permission, as it would aid a line of road to Boston to the detriment of New York. As the laws of New York prohibited building bridges across navigable waters the work came to a standstill until the then chief engineer of the road, Mr. Paine, the father of the present president of the society, conceived the idea of circumventing the laws by building a steam vessel 320 ft. long, upon which trains could cross. This was done, and the crossing was used for seventeen years. It was while this was building the speaker had his attention directed to the feasibility of the plans. At the time the Prairie du Chien pontoon was built, Mr. Lawler was connected with the transportation business of the Chicago, Milwaukee & St. Paul Railroad, and he thought that a cheaper method of crossing the Mississippi River than by ferrying could be adopted. He worked out this plan, and it proved a success. All the speaker had to do with the matter was to give Mr. Lawler the benefit of his experience with the steamboat bridge across Lake Champlain. In answer to one or two questions, Mr. Lawler explained how the pontoon was adjusted to the stage of water by means of a self-adjuster, so that there was no depression or displacement of the frame work of the pontoon, no matter what was the stage of water.

SCALE OF HARDNESS OF COMMON METALS.—A new scale for comparing the hardness of metal has been compiled by Mr. Galliner, who in his experiments used small cylinders with conical points, and passed them loaded up to five kilogrammes over polished plates of the respective metals, from which they did not materially differ in hardness. Thus he found, indicating the hardness of pure soft lead by 1, that tin is represented by 2; hard lead by 3; copper, 4 to 5; metal for bearings (85 copper, 10 tin and 5 zinc), 6; tempered cast iron, 7; fibrous wrought iron, 8; grey cast iron, 10 to 11; mild steel, 12 to 13; crucible steel, blue, 14; violet, 15, straw color, 16; hard bearing metal (83 pper, 17 zinc), 17; and very hard steel, 18.

WATER-WORKS.

MEETING OF THE NEW ENGLAND ASSOCIATION.

The New England Water-Works Association held its second annual meeting at the Bay State House, Gloucester, Mass., Thursday, June 21. Representatives were present from all the New England States excepting Vermont.

The business meeting was called to order at 10 A. M., the President, James W. Lyon, of Lynn, in the Chair, and R. C. P. Coggeshall, of New Bedford, Secretary. The members present were J. Stewart Brown, of Worcester, Edwin Darling, of Pawtucket, Robert M. Gow, of Medford, S. E. Granniss, of New Haven, Conn.; Frank E. Hall, of Worcester, Joseph C. Hancock, of Springfield, Jas. H. Hathaway, of New Bedford, W. W. Hawkes, of Malden, H. G. Holden, of Lowell, H. N. Hyde, Jr., of Newton; Thos. C. Lovell, of Fitchburg, Jas. W. Lyon, of Lynn, C. W. Morse, of Haverhill, Hiram Nevons, of Cambridge, W. H. Richards, of New London, Conn.; H. W. Rogers, of Lawrence, H. L. Schleiter, of Meridan, Conn.; Phineas Sprague, of Malden, Joseph G. Tenney, of Leominster, C. K. Walker, of Manchester, N. H.; W. C. Wilcox, of Waltham. The fine members present were the Corliss Steam Engine Co., of Providence, William B. Sherman, Secretary; and the National Meter Co., of New York, John Kelley, President; Nat'l Dennet, of Somerville; Chas. E. Bliss and L. P. Carpenter, both of Attleboro, were present as visitors.

The following new members were admitted:

Active Membership:

Thos. H. Brady, Supt., New Britain, Conn.
Chas. A. Northend, Secy., " "
James Porter, Supt., Greenfield, Mass.
David W. Horan, Supt., Clinton, Mass.
Nathl. I. Jordan, Treas., Auburn, Maine.
George A. Ellis, City Engineer, Springfield, Mass.
Thomas A. Hodge, Supt., North Adams, Mass.
William R. Billings, Supt., Taunton, Mass.

Fine Membership:

Hartford Meter Company, by E. C. Terry, Secy., Hartford Conn.
Chapman Valve Mfg. Co., by Jason Giles, General Manager, Indian Orchard, Mass.
Union Water Meter Company, by John C. Otis, Treas., Worcester, Mass.
Knowles Steam Pump Co., by W. D. Fiske, Boston, Mass.
Equitable Water Meter Co., by C. H. Baldwin, Boston, Mass.
Geo. F. Blake Mfg. Co., by Geo. F. Blake, Jr., Boston, Mass.

The membership is now 51.

President Lyon briefly sketched the history of the Association.

Efforts to form such an association were made several years since, but not until last year was such an organization effected.

With the radical changes in the construction of water works and the increasing demand for water, there is, he said, abundant room for inventors.

The Executive Committee's report stated that the affairs of the Association were in a prosperous condition.

Edwin Darling, of Pawtucket, R. I., the Treasurer, reported the receipts as $245, and balance on hand $157.14.

These officers were elected for the ensuing year: President, Frank E. Hall of Worcester; Vice-Presidents, Charles K. Walker of Manchester, Horace G. Holden of Lowell, Edwin Darling of Pawtucket, R. I.; N. I. Jordan of Auburn, Me.; S. E. Granniss of New Haven, Conn.; Secretary, R. C. P. Coggeshall of New Bedford; Treasurer, Edwin Darling. Executive Committee—H. W. Rogers of Lawrence, Thomas E. Lovell of Fitchburg, William R. Billings of Taunton. Finance Committee—James H. Hathaway of New Bedford, J. Stewart Brown of Worcester, Albert S. Glover of Newton.

While awaiting the report of the nominating committee, Mr. W. B. Sherman, of the Corliss Steam Engine Company, exhibited and explained a diagram showing the duties of pumping engines and the corresponding amounts of fuel consumed under different heads.

Dinner was served at 1 o'clock, and after dinner remarks were made by Mayor Hildreth, President of the Common Council, E. O. Parker and Chief Engineer Combs. Alderman Brady, Councilman Childs and Capt. Williamson, of the Fire Patrol, were present as guests. After the speaking the members and guests took carriages and were driven to the Fire Patrol house and the Union Water Meter Works on Hermon street. Next a visit was made to Tatnuck Brook and the Holden reservoir. Returning to the hotel the party were entertained with supper by the Union Water Meter Company.

At the evening session, President Hall in the Chair, it was voted to hold the next annual meeting in Lowell the third Thursday in June, 1884. An invitation was accepted from Treasurer Darling to visit Pawtucket, R. I., next fall.

The topic, "The causes and prevention of the waste of water," was presented in a paper prepared by Hiram Nevons, of Cambridge; Edwin Darling, of Pawtucket, R. I., and Frank E. Hall, of Worcester. Mr. Nevons read the paper, in which it estimated the average waste at from 30 to 50 per cent. of all water pumped or put into the supply pipes. In the discussion which followed, Mr. Lyon, now of Lynn, formerly Superintendent at Salem, urged the importance of the house-to-house inspection, and thought more attention should be given to the time hand hose is used for sprinkling lawns. Mr. Nevons thought the time coming when the use of meters would be necessary to protect the water supply. With the growth of the country and the introduction of water into cities and towns, it will eventually become a question of supply, and to have water enough to meet all demands, every precaution will be necessary to prevent waste. Others who participated in the discussion were Treasurer Darling, Messrs. Billings, of Taunton; Baldwin, of Boston; Hodge, of North Adams; Ellis, of Springfield; Coggeshall, of New Bedford; Hawkes, of Malden. President Hall said that the causes of waste were of a local character.

In the discussion of water meters, J. Stewart Brown advocated their use. Mr. Schleiter, of Meriden, Conn., said the experience in his town was that the use of meters doubled the revenue, and Treasurer Darling favored the obligatory use of meters. Nearly every town or city excepting Worcester has a minimum rate for meters.

There was some general talk on the advantages and disadvantages of iron, lead, cement and galvanized pipe. A vote of thanks was passed to Water Commissioner Hall and Water Registrar Brown, to the mayor and others.

Agreeable to the invitation of the Chapman Valve Manufacturing Company, the members of the Association left Worcester early on Friday, June 22, for Indian Orchard, at which place the works of the company are located. Three hours were spent at this place. The details of manufacturing valves was minutely shown and explained. Among other things that attracted attention was a hydrant throwing four streams, arranged by an independent valve so that any one or more could be cut off or let on without interfering with the other streams.

The members of the Association were then driven to Springfield, where the Valve Company provided an excellent dinner at the Warwick House, after which they were taken in charge by the Springfield Water Commissioners, who showed them the different points of interest in the city.

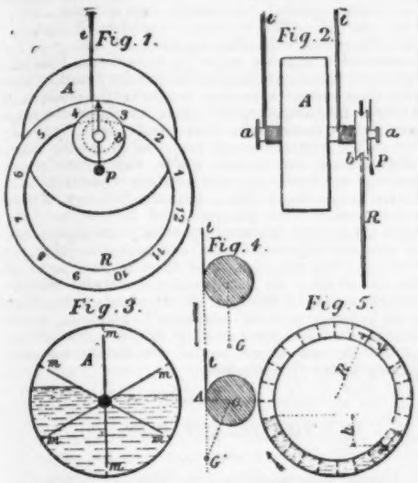
A visit was made to the office of the local water commissioners, where a vote of thanks was passed by the members of the Association for the courtesies they had received from the Valve Company and the Springfield Commissioners.

THE SPYGMOGRAPH.

That "man is fearfully and wonderfully made," may well be believed without the evidence of the phenomena of human existence developed by the advance scientific investigation of the present day. The mechanism of physical life is well, and even startlingly stated in the following statements of the Edinburg *Review:* As with each stroke the heart projects something like six ounces of blood into the conduits of the system, and as it does so some 70 times every minute and 4,200 times in an hour, this implies that it does the same 100,800 times in 24 hours, 40,000,000 times in a year, and more than 2,500,000,000 times in a life of 70 years. The mechanical force that is exerted at each stroke amounts to a pressure of 13 pounds upon the entire charge of blood that has to be pressed onward through the branching network of vessels. According to the lowest estimate that has been made this gives an exertion of force that would be adequate in another form of application to lift 120 tons 1 foot high every 24 hours. Yet the piece of living mechanism that is called upon to do this, and do it without pause for three score years and ten without being itself worn out by the effort, is a small bundle of flesh that rarely weighs more than 11 ounces. It is in the nature of the case, also, it must be remembered, that this little vital machine cannot be at any time stopped for repair. If it gets out of order it must be set right as it runs. To stop the beating of the heart for more than the briefest interval would be to change life into death. The narrative of what medical science has done to penetrate into the secrets of this delicate force-pump, so jealously guarded from the intrusion of the eye that it cannot even be looked into until its action has ceased, is, nevertheless, a long history of wonders. By means of the spygmograph, a writing instrument attached to the wrist by a system of levers and springs, the pulse is made to record actual autographs of cardiac and vascular derangement.

AN OLD WATER CLOCK.

Although the pages of our paper are of course largely devoted to the record of new inventions, yet the description of old mechanism, especially if it embodies an ingenious application of a mechanical principle, is always read with interest. Of such a character is the water clock we are about to notice, and the arrangement of which is conspicuous by its simplicity. Its mode of working has even been a puzzle to many of those who have seen it.



The annexed Figs. 1 and 2 show the outward appearance of the mechanism, in which *A* is a hermetically closed drum of sheet brass, about 5½ in. to 6 in. in diameter and ¾ in. wide. It is mounted on a small steel axle *a*, which bears on one end a small grooved pulley *b*. Into the groove of this pulley a ring *R* is loosely hung with the numbers 1 to 12 inscribed on its circumference. A pointer *p* is placed on the projecting end of the axle *a*, without, however, being fixed to it. This pointer is weighted on its lower extremity so that it hangs vertically, pointing always to that number on the ring *R* which is uppermost. Around the axle *a* two threads *t t* are wound which are fixed to the ceiling or to some other elevated point.

Now, if the apparatus is left to itself, it does not roll down rapidly as might be expected, but it descends slowly, almost imperceptibly, so that it requires even several days to traverse the height of a few yards. A somewhat closer examination shows that the drum *A* is partly filled with some liquid (probably water), and on the surface of the drum there are found indications of an internal division into several parts by means of radial partition walls. There are four specimens of this peculiar apparatus known, three of them having been found in Bohemia, and one in Moravia. The first was discovered at Brünn (Moravia) in 1846, but it had been quite forgotten, until it was brought into notice again about two years ago, when a similar water clock was found at Rehdörfel (Northern Bohemia). This latter specimen has a drum of 5⅞ in. diameter and ¾ in. wide, which shows traces of five internal partition walls. It is said to have been constructed by a monk in the seventeenth century. Public attention having thus been drawn to the subject, two other specimens were brought to light at Prague; one of them had been found some forty years ago among many other old apparatus at the Polytechnic School of Prague, but it had not been taken notice of since that time. It has a drum of 5½ in. in diameter and 2 in. wide, with eight partition walls. The pointer *p*, as well as the ring *R*, are wanting. The other specimen is in the possession of a merchant, who had found it among some old iron. It is in every respect similar to the others, and having been set going after a pause of perhaps two centuries, shows the time very well.

Having thus described the apparatus and its history, it remains to explain the principle of its construction.

None of the specimens known have been opened as yet from fear of spoiling the "mechanism." Thus, of course, we have no positive knowledge of the internal arrangement. But certainly it cannot essentially differ from that shown in Fig. 3. According to that supposition the drum *A* is simply divided into a number of sectors by radial partition walls, which are pierced by the holes *m m*. Now, when the drum revolves in the direction of the arrow, the water which partly fills the drum is somewhat raised on the left side, and thus the centre of gravity, which had been at first directly under the centre of the drum, is likewise somewhat shifted to the left. It is also easily understood that the centre of gravity will soon attain a position, where the head of the water on the left hand is just sufficient, to pass through the orifices *m* the same quantity of water that is raised by the rotating partition walls, so that the centre of gravity will undergo no further change of position in reference to the drum.

Let us now proceed to a closer examination of the mechanical action. In Fig. 4 the shaded circle represents an enlarged section of the axle *a*, and *G* is the centre of gravity of the water contained in the drum.

When the apparatus begins to fall, the centre of gravity is shifted to the left, as we have already shown before. As a matter of course, the velocity of the drum, beginning at zero, will constantly increase, but the rate at which the velocity increases will become less and less as the centre of gravity will be nearer to the "line of suspension" *t t*. When the centre of gravity has reached this line—being at G_1—no further acceleration will occur. From that moment the drum will descend with a constant velocity equal to that which the drum had acquired at the moment referred to.

If at that moment we call the downward velocity of the centre O_1 *v*, and the circumferential velocity at the point G_1 : *u*, we have

$$\frac{u}{v} = \frac{R}{r}, \text{ if } r = O_1 ; A_1$$

is the radius of the axle of the drum and $R = O_1 G_1$ the distance of the centre of gravity from the centre of the drum. The velocity *v* will therefore be,

$$v = u \frac{r}{R} \quad . \quad . \quad . \quad . \quad (1)$$

Suppose now the drum, instead of being arranged as in Fig. 3, to be constructed as shown in Fig. 5. In that case the drum forms a ring whose mean radius is *R*, its cross sections being *F*. There is a large number of partitions in this ring, each partition wall being pierced by a hole of an area *f*. The ring is partly filled with, water as shown in the figure. Now, if *u* is the circumferential velocity of the ring (which turns in the direction of the arrow), and *w* is the velocity of the water when flowing through the openings in the partition walls, the centre of gravity will remain at a constant position, if :

$$w f = u F \quad . \quad . \quad . \quad (2$$

And, as we have (theoretically) :

$$w = \sqrt{2 g h},$$

h being the head, as shown, equation (2) may be written thus :

$$f \sqrt{2 g h} = F u$$

whence :

$$u = \frac{f}{F} \sqrt{2 g h} \quad . \quad . \quad . \quad 3)$$

If we introduce this value of *u* into equation (2), we have :

$$v = \frac{f}{F} \cdot \frac{r}{R} \cdot \sqrt{2 g h} \quad . \quad . \quad . \quad (4)$$

In finding the velocity *v* we have supposed an arrangement of the drum which does not agree with the actual construction : at the same time we have disregarded all resistances. Thus it is clear that equation (4) is not in any way an exact expression of the velocity actually acquired by the drum. But although the actual velocity may considerably differ from that given in equation (4), yet this equation is sufficient to show that the velocity *v* can be made very small, for it is even less than the velocity corresponding to a face through the height *h*, which certainly will be only small.

We have no intention of giving here an analytical investigation into the problem, which would have required an amount of work quite out of proportion with the importance of the subject, but we think that we have cleared up the question sufficiently to show that there is really no puzzle in the slow motion of the drum ; nevertheless, we freely confess that no amount of calculations will ever remove the strange impression which everybody must feel when looking at the drum as it hangs almost motionless in two threads wound freely around its axis. It may be also mentioned that Mr. Wenzel, who discovered the clock above described at Rehdörfel, has constructed a similar apparatus. The drum of this apparatus was of wood, and filled with mercury, the motion of which could be observed through the glass cover of the wooden drum.—*Engineering.*

THE STATUS OF THE RAPID TRANSIT QUESTION IN BROOKLYN.

Ever since the success of the elevated railroads in New York City was demonstrated, the people of Brooklyn have recognized the importance and necessity of the rapid transit system to the further growth of the city, and numerous schemes have been projected to supply this want to different parts of Brooklyn. The first scheme which had the greatest promise of success was the so-called Bruff Elevated Railroad, which was intended to supply the district between Myrtle and Flushing avenues as far as Grand avenue, and beyond that point between Gates and De Kalb avenues, as far as Broadway, along which it was to run to East New York. Considerable work was done on the road. Nearly all of the foundations were laid between Fulton Ferry and East New York, and with the exception of a few gaps, the superstructure was erected on the line from Bedford avenue to the ferry. After doing this much the funds of the company gave out, work was stopped, and finally a receiver, or rather two, were appointed. Every year it is reported that the company has completed arrangements that will enable work to be resumed and the road finished in a short time, but thus far nothing preceptible has been done. The latest report is, that a syndicate has been organized to purchase the road as it stands, and that Mr. Shreve, the chief engineer, has been paid his salary long overdue, and re-engaged for the new enterprise.

Prominent among the other schemes is the so-called Culver to supply rapid transit to South Brooklyn, along Sixth avenue, and connect with his Coney Island Railroad, at its present terminus. Then there was the Bond scheme which proposed to appropriate the principal streets of Brooklyn for elevated roads. Owing to the fact that it was the dreadful "foreign capital," all the way from Boston that was to do this work, and that every one, although wishing rapid transit, wishes it on another street than his own, a cry was raised that Brooklyn's business streets would be ruined by such an elevated system.

Another project was soon broached. This time it was not an elevated, but an underground road. It was proposed to take London as a model, and build a system of roads extending from the Brooklyn terminus of the bridge under Washington and Adams streets to Fulton street. Then beneath Fulton street to Flatbush avenue, which it was to follow as far as the Long Island Railroad depot. This was to be the first work to be accomplished, it being expected that the tracks of the Long Island Railroad along Atlantic avenue would be depressed, similar to the road on Fourth avenue, New York, thus giving the Long Island Railroad a terminus at the bridge. This enterprise had a great many enthusiastic advocates, and plenty of capital, but when the time came the funds were lacking and the scheme is probably dead.

All plans of rapid transit included passing over the bridge and landing passengers at City Hall, New York. The general feeling now is that the time has arrived for rail communication, and the latest project is one by the Long Island Railroad Company itself, which proposes to extend its road from its present terminus at the junction of Flatbush and Atlantic avenues, by means of an elevated structure along Flatbush avenue to Fulton street, and from there to take private property for its line, under the general railroad law, to the bridge terminus.

This project, it would seem, is the easiest of accomplishment, and probably is the one on which Brooklyn must rely for its first rapid transit system.

THE BOULDER OF THE FLUME.

A gentleman writes from Lincoln, N. H., as follows :

I started Thursday, 21st, on a business trip to Lincoln. Arriving at Plymouth, I learned that the Pemigewasset Valley Railroad was washed out, and no trains could run for several days. I stepped aboard the mail stage, and after a ride of 12 or 14 miles was invited to step out, 9 miles this side of my destination, to make the rest of my journey the best way that I could through wreck and ruin. Last Wednesday, early in the forenoon, the clouds began to thicken and settle down in the mountain region, and between 10 and 11 o'clock the lightning was seen darting in all directions, and the heavy roar of the thunder gave warning that a terrible shower was near at hand. Soon rain fell in torrents, such as was never known by the "oldest inhabitant." During the heaviest of the shower a thunderbolt that jarred the country for miles around darted down, entering Mount Liberty, or the South Hay Stack, near the top, starting a mass of rock down the steep side, which widened and deepened as it pushed its huge bulk along, leaving a channel 50 or 60 feet wide and about 30 feet deep. The flood of water, carrying the huge mass with all of the heavy forest with it, entered the stream about half a mile above the

Flume, cutting away both sides of the stream in its course; then entering the Flume, swept away the pine log lying across the top of the high walls, and the great boulder that has hung so many years suspended between the walls—a wonder to thousands—and bearing it down stream about 1,000 feet below its old resting place beside the newly-cut channel. The water was raised to the hight of nearly 50 feet in the Flume. After passing the highest part of the Flume it spread to the right and left, taking down nearly two acres of the heavy forest clean. Every tree, large and small, was stripped of its limbs and bark and broken into fragments. There must have been more than 100,000 feet of timber, besides a large quantity of small wood, swept down in its course of nearly one and a half miles. The great bulk of the stone that was taken down was lodged on the "apron," covering more than two-thirds of it with huge blocks of stone many feet deep, and clearing off a new "apron" lower down. Nearly all of the space from the bridge up to the end of the Flume is covered with stone and broken timber.

A little south of this was another slide, much larger than the one described, but it did not reach the Flume Brook. There was one also on the east branch about the same time, as shown by the green trees that floated down that stream for nearly two hours. It appears that a very large slide came down many years ago above the Flume, which may have lodged the great boulder that has just been forced from its position by this torrent. It is worth going a long distance to see what has been done by water in so short a time, for no pen can describe the reality. Some think it has added to the natural attractions of the place.

ILLINOIS LAWS RELATING TO ROADS AND DRAINS.

At the recent session of the Illinois Legislature the following sections were passed:

Senate bill 111, to amend section 107 of act in regard to roads and bridges, by providing for the maintenance by different townships interested in bridges crossing lines. The present law provides for joint contracts between the commissioners of the respective townships. The law adopted provides that whenever the commissioners of highways of either town shall refuse to enter into such contract, the commissioners of the other town shall petition the supervisor of such town to call a special town meeting to vote upon the proposition as to whether such town shall proceed to build and maintain such bridge or bridges at its own expense. For this purpose towns are authorized to borrow money.

Senate bill 401 institutes a code of procedure for the construction and maintenance of gravel, rock, macadam, or other hard road. The machinery devised to accomplish this purpose is rather complicated, beginning with a petition for the road in question, and its ratification by a town or road district meeting. The tax shall not exceed $1 on each $100 assessed valuation. The tax shall be a special one, extended upon the books of the county collector, and the work shall be let by the commissioners of highways to the lowest responsible bidder, and shall be carried on and completed by an engineer appointed by the commissioners of highways.

Senate bill 315, the new road law, makes all roads properly laid out or which have been in use twenty years public highways. It puts these roads in charge of three commissioners of highways in each township, as at present, and requires them to construct permanent roads as fast as means will permit. It requires work to be done in accordance with the best known methods of road-making, or to let by contract, and to prevent as far as possible the seeding of weeds, thistles, etc. Full provisions are made for draining the road with tile, and for entering adjacent lands and carrying drains through them, and also for contracting with owners to drain into it, they paying part of the expense. The planting of willows along public highways is declared a nuisance. All road taxes, including poll tax, must be paid in money. A levy of 60 cents on the $100 is permitted, if needed, with an additional levy of 40 cents (making $1 in all), in view of any contingency, with the consent of the town board. The supervisor of the township is made ex-officio treasurer of the commissioners, and the town clerk their clerk. Full provisions are made for laying out, altering, or widening roads. Penalties are provided for obstructing the highway by throwing weeds or trash upon it, leaving cuttings of hedge upon it, felling trees across it, turning water into it, or in any other of many enumerated ways.

Senate bill 243, to maintain and improve ditches heretofore constructed to drain certain swamp land or drains heretofore made by any county, or by any county contracting with an incorporated company, to drain the swamp and overflowed lands donated to such county by the State, are hereby declared public ditches or drains, and may be preserved and improved by the several county boards in the counties where these ditches lie.

Senate bill 223, to provide for additional assessments for the maintenance and repair of drains and ditches.

House bill 99, to legalize drainage districts heretofore organized, and also to legalize the assessments of benefits in such districts and certain sales made in pursuance thereof, and to authorize drainage districts to purchase lands at certain sales for delinquent special assessments.

Senate bill 346 permits the connection of private drains with water-courses.

House bill 417, to divide cities and villages subject to overflow and inundation into improvement districts, and to provide ways and means to raise the streets, lots, and blocks above the line of overflow.

Senate bill 381 amends "An act to provide for the construction, reparation, and protection of drains, ditches, etc."

SAND-BOX FOR LOWERING THE CENTERS OF ARCHES.

BY J. SMITH.

(Professional Papers on Indian Engineering.)

For striking the centers of a four-span bridge over the Tamal River, in the Midnapore district, there was required for holding the sand an entirely closed receptacle, which would gradually collapse as the weight came upon; it bags, open cylindrical or rectangular boxes being unsuitable under the conditions. After considerable thought, it struck the author that empty kerosene-oil tins would answer the purpose, and if so, hardly anything could be cheaper, as they only cost one anna per tin.

The weight which the tins filled with sand would sustain without collapsing having been ascertained by experiment, a sufficient number were placed on the top of masonry pillars and were inclosed by masonry in mud-mortar, so as to prevent their being tampered with. This was also needed as a reserve support in case of a tin bursting through faulty construction. The kerosene-oil tin "sand-boxes" were made to carry the centers by templates and pillar-plates, as usual; and to allow of the immediate collapse on the sand being removed, the templates were made of such a size as to lie within the box. In striking the centers, the casing-bricks were first removed. Coolies, armed with short and sharp-pointed pegs of hard wood and ordinary hand-hammers, were stationed at each box. At a given signal every man struck a hole at the side of his box, and on the pegs being simultaneously removed, and another hole made at the top of the tin, the sand ran out. The lowering, which was very easy and gradual, could be arrested at any point by allowing the sand to accumulate in front of the holes. One side could also be lowered quicker than the other by simply driving another hole into the box and increasing the flow of sand. The maximum weight supported by one of the kerosene-oil tins used was, by calculation, 7.7 tons. No bulging or crushing was perceptible before the sand was run out.

HOW THE EXPRESS BUSINESS STARTED.

I have just found an old letter, addressed to me on the 27th of October, 1838, which led to results quite overpowering in their magnitude. The writer is William F. Harnden. He tells me that he has applied for a post of conductor upon the Western Railroad, and solicits my influence, as Treasurer of the road, "should you think me worthy of the office." Harnden had been selling tickets at the Worcester Railroad depot, but found this occupation much too sedentary for his active nature. He was a man who wished to be moving. For some reason, which I do not recall, Harnden did not get the conductorship; but his application brought me in contact with this lithe, intelligent young fellow, who wished to be on the go, and I suggested to him a new sort of business which, in the hands of a bright man, I thought might be pushed to success. As director and president of the Providence Railroad, I was compelled to make weekly journeys to New York, where the bulk of our stock was held. The days of my departure were well known, and I was always met at the depot by a bevy of merchants' clerks, who wished to intrust packages of business papers, samples of goods and other light matters to my care. The mail establishment was at that time utterly insufficient to meet the wants of the public. The postage was 17 cents upon every separate bit of paper, and this was a burdensome tax upon the daily checks, drafts and receipts incident to mercantile transactions. I was ready to be of service to my friends, though some of them thought my good nature was imposed upon when they found that I was obliged to carry a large traveling-bag to receive their contributions. I kept this bag constantly in sight on my journey, and, upon arriving in New York, delivered it to a man whom the merchants employed to meet me and distribute its contents. Now, it occurred to me that there was an opportunity for somebody to do, for an adequate compensation, just what I was doing for nothing. I pointed out to Mr. Harnden that the collection and delivery of parcels, as well as other transportation, might be undertaken by one responsible person, for whose services the merchants would be glad to pay. The suggestion fell upon fruitful soil. Harnden asked me for special facilities upon the Boston & Providence road, which I gladly gave him, and with the opening of the year he commenced regular trips (twice a week, I think, he made them), bearing in his hand a small valise, and that valise contained in germ the immense express business—contained it as the acorn may contain the forest oaks that may come from it; but many generations are required to see the magnificence of the forest, while the growths of human enterprise extend to their wonderful maturity in one short life. Harnden's fate was that too common with pioneers and inventors. He built up a great business by steady industry, saw all its splendid possibilities, tried to realize them before the time was ripe, and died a poor man at the age of 33. In attempting to extend the express business to Europe he assumed risks that were ruinous, and the stalwart Vermonter, Alvin Adams, took his place as chief in the great industry which had arisen under his hands.—*Josiah Quincy in the Independent.*

THE OLDEST CITY.

[Special Correspondence of the Minnesota Tribune.]

The big card this summer is the tertio-millennial celebration to be held at Santa Fe, N. M., beginning on the 2d of July and closing the 3d of August. This is intended to commemorate the 333-1 anniversary of the Spanish settlement of Santa Fe, and will be an event of much more than mere local or territorial importance. The entire country has an interest in it. Santa Fe is the oldest city in the United States, being 15 years older than St Augustine, and 57 years older than Jamestown. The programme of attractions offered is the most novel and unique ever presented anywhere. In connection with the celebration there will be a grand mining and industrial exposition, which will include an exhibit of minerals from each mining region of the territory, metallurgical and general machinery, agricultural, horticultural and floral displays, manufactured goods, etc. New Mexico is very rich in minerals, though it cannot be said that the development of her resources has yet fairly begun. General attention was attracted to the wealth of the territory in consequence of the fine display made at the Denver mining exposition last year, and since then the influx of miners and prospectors into the territory has been reasonably large. At the present time the population of New Mexico is about 120,000.

THE CITY OF SANTA FE.

It is rather strange, that so comparatively new a country as this should contain a city so aged as Santa Fe. Jamestown was founded in 1607; when we acquired Florida, and thus obtained possession of St. Augustine, we had a city that was born in 1565. But when came the American conquest of 1846 the latest acquisition in the line of antiquity was Santa Fe, whose date is 1550, and which was a town of some importance for quite a time previous to that, though no reliable data regarding this can be obtained. History is more or less misty previous to 1550, the chronology of that period being more or less dim and incomplete. This much is known, however, which is that Santa Fe is more than a third of a thousand years old. It was in 1550 that the first Spanish Governor of the territory came out from old Mexico, and after looking around for quite awhile selected Santa Fe, then called Tegua, as his headquarters and capital of the territory, and ever since that it has remained as the seat of political and military operations. The town has been written up so many times by correspondents since the advent of the railroad that its various characteristics are familiar to the average newspaper reader. It has now about 10,000 inhabitants, not more than one-third of whom are Americans. The trade of the town is rather large, aggregating about $8,000,000 yearly. Several American firms are doing a very extensive business, but the main part is transacted by old firms, which have been located there for the better part of half a century. As a place of residence Santa Fe is delightful, the climate being equable and not given to any sort of eccentricities. In winter there is very little cold

weather, while in the summer the days are clear and bright, and the nights cool and refreshing.

ABOUT THE CELEBRATION.

There is burry and bustle apparent upon every side now in consequence of getting ready for the celebration. The grounds selected are in the city, adjacent to Fort Marcy, and but a square from the plaza, which is the heart of the town. Extensive exhibition buildings have been erected for the accommodation of the displays; a race-track has been constructed and stables built; native growths of the territory, a lake, fountain and trees adorn the grounds. Those who are interested in practical things will find it pleasant to study the gold and silver ores and other minerals, agricultural, horticultural and other samples of the products of the ground and stock exhibit. The industry of raising cattle and sheep in New Mexico is a very extensive one, and is growing rapidly. The historical and novel features of the celebration will in all probability be the most attractive portions to the average visitor. This part of the programme, if carried out, will be most entertaining. There will be a collection of old Aztec curiosities and the implements, arms and ornaments of the stone age; there will also be relics of the early Spanish conquerors, loaned by their present owners. The collection will be very large, and of the greatest historical and archæological interest. However, to return to the novel features of the programme. Interspersed with the other exercises are to be various Indian games, races and dances by Pueblo Indians from the neighboring Pueblos. These are the direct descendants of the people the Spaniards found here, but of course do not, and can not be expected to contain all the characteristics of their ancestors. There is also to be a sham fight and ambuscade by the Zuni Indians, with an exhibition of their peculiar rites and ceremonies, under the direction of Mr. Frank Cushing. These Zunis are now making preparations, and have been busy getting regalia for one of the dances they propose to give, representing the gods and heroes of their folk-lore mythology, which, though one of the most ancient of their observances, is not one of their religious rites. Native Mexican dances are to be given, and various games and juggling indulged in; also an original Aztec dance, in which both Mexicans and Indians will take part, representing both forms of the dance. The San Domingo and Sandid feast will be interesting. After a wild dance around the roasting ox, the first cut of which goes to the champion, there will be a concert of tom-tom, reed instruments, hautboys and other music. A band of Mescalero and Jicasilla Apaches, numbering about 40, and a like number of Navajos, are to camp upon the grounds. The former have seen little or nothing of civilization and, in fact, know nothing about it. These will indulge in their war and other peculiar dances, to the accompaniment of their barbaric music, extending throughout the day and around their camp fires at night. The revival of the ancient days of Spanish chivalry is to be accomplished through the instrumentality of a mounted tournament, in which Mexican caballeros will vie with each other in courage and skill.

ON THE IMPROVEMENT OF MARSH-LANDS.

BY G. MALASPINA.

The necessity for improving marsh-lands has been recognized from very early times, and in Italy great works have been executed for this purpose throughout the historic period. In 1806 and 1810 laws providing for such works and the method of raising the necessary funds were enacted, and the greatest work since undertaken was the improvement of the Tuscan *maremma*, commenced in 1828 and continued by the method of raising the level of the ground, for forty years.

The Venetian Marshes.—The lower part of the Venetian plain, embracing the provinces of Friuli, Venice, Padua, and Rovigo, is bounded by a broad band of marsh-lands which extend to the sea. These marshes are formed by the deposits of the Po, the Adige, the Brenta, the Bacchiglione, the Piave, the Livenza, the Tagliamento, the Isonzo and other rivers. Through the formation of these deposits the area of land is constantly increasing, and many once-flourishing seaports are now some miles from the shore, and on their ruins stand wretched villages, centers of fever and disease. Broad lagoons which formerly existed have silted up, and it is only by immense works that the Venetian lagoons have been preserved. During the last forty years the lagoon of Chioggia has silted up to the extent of one-half, and the remainder will probably suffer the same fate in another thirty years.

The action of the rivers in forming the delta is very irregular, though in ordinary times they have a tendency to form their own beds and to raise the ground on either bank up to the limit of average floods, yet occasionally, owing to exceptional causes, one river will overtop its bank, flow into the basin of another, cut itself a new channel, and cause irregular hollows and formations of deposit. This action is aggravated by the premature construction of artificial banks, which, though allowable in the upper parts of the river when the channel is already well-defined, ought not to be formed in low land, where the natural action of the river in raising the level of the ground is incomplete. In such cases it silts up its own bed, and the banks have to be constantly raised. The indiscriminate destruction of forests increases the evil by allowing the water to run off more rapidly. The result of these various causes is the formation of extensive tracts of land which must of necessity be marshy, as they lie too low for natural drainage into the sea, the river water being generally above the level of the adjacent land. In fact, there is not an acre of land in the middle and lower Venetian plain which is not dependent upon some special hydraulic arrangement, either for protection against inundation, for drainage, or for irrigation; so that the whole district is divided among a network of societies governed by special laws for regulating the various water-rights. Another cause of the formation of the marsh-lands is that sand dunes are formed along the coast and offer further obstruction to natural drainage. Salt-marshes, too, exist on the coast, and these are the most unhealthy of all; the mixture of salt and fresh water causes the death and putrefaction of animals and plants, and the resulting miasma spreads inland.

Improvements effected in the Venetian Territory.—The first attempt at draining these marshes was made in 1807, when a few farmers set up a small bucket-wheel, worked by three men, for draining a few acres. Presently another wheel was started, and by degrees horse-power and steam on a large scale were introduced.

These attempts were not always successful; but an area of 15,000 acres having been effectually drained with most satisfactory results, an impetus was given to similar enterprises in the district, and very large tracts of useful and pestilential land have been converted into flourishing and healthy farms, villages and towns. The machines that have been found most successful are bucket-wheels and turbines.

The new Law Relating to the Improvement of Marsh-Lands.—This law, founded upon the principle that the owners have no right to let their property remain a source of danger to the public, empowers the State to execute such work when the owner will not. The law deals first with sanitary, second with agricultural and sanitary improvement combined. Half the expense of works of the first class (in which are included the construction of roads for placing the improved lands in communication with the nearest towns), is borne by the government, one-eighth by the province or provinces interested, one-eighth by the commune, and one-fourth by the proprietors, among whom are included those of neighboring lands benefited by the work. The sums contributed from public funds are to be repaid when the land increases in value. The supply of drinking water to the improved lands is included among the works to be provided for.

Works of the second class are to be undertaken by associations, which may be either voluntary or compulsory, the former requiring the consent of all the parties interested; the latter being initiated by some public authority. In the former case all the expense is to be borne proportionately by those interested; in the latter, one-tenth is to be found by the nation, one-tenth by the province, one-tenth by the commune, the remaining seven-tenths by the proprietors. Provision is made for enabling the association to borrow from the treasury to the extent of three-fifths of the value of their property.

From abstracts of papers in foreign perodicals prepared for the English Institution of Civil Engineers.

NEWS OF THE WEEK.

THE BATAVIA, ALBION & LAKE ONTARIO RAIL ROAD is a projected three-feet gauge to run from Batavia through Albion to Oak Orchard Harbor on Lake Ontario, a distance of 30 miles. The capital is $50,000. N. G. Beardslee, of Warsaw, N. Y., is appointed chief engineer. Iron bridges will be used.

A LARGE CONTRACT HAS BEEN AWARDED to L. M. Shute, of Philadelphia, viz., to build a line of railway from Cornwall to Sault Ste. Marie, a distance of about 700 miles. At the latter terminus the promoters of the road expect to make connections with the Northern Pacific Railway. They claim to have power to construct a bridge over the St. Lawrence in order to obtain eastern connections.

THE PITTSBURGH, CLEVELAND & TOLEDO is progressing rapidly all along the line under the supervision of Messrs. Warren & Cleveland, principal contractors. Over 1,000 men are in their employ.

DAKOTA RAILROAD.—General Manager Merrell has been examining in Dakota the route surveyed some time ago for the connection of the Iowa and Dakota divisions with the Hastings & Dakota, through the branch north and south from Aberdeen. It is the general understanding that it is the purpose to bind the connecting links this season, and to complete the Jim River Valley line from Mitchell to some point not made public on the Northern Pacific, but confidently believed to be Jamestown. It is stated that the Milwaukee and St. Paul has made arrangements to survey two or three counties in Dakota, west and north of Aberdeen, in Dickey County, in behalf of the James River Valley line, and in McPherson.

THE INDIANA INSANE ASYLUMS are to be at Richmond, Logansport and Evansville, respectively. The Richmond Asylum will be modeled after the Illinois Asylum at Kankakee.

THE SHAMOKIN, SUNBURY AND LEWISBURG RAILROAD loan has been entirely taken. The road is now completed and will be opened July 2.

THE BIRMINGHAM (ALA.) & MEMPHIS (TENN.) RAILROAD has been chartered by the Secretary of State.

THE NORTHERN PACIFIC construction train is at Missoula, and now only 120 miles remain to be completed to close the gap between Helena, Montana, and the former place.

THE LABORERS blasting rocks on the railroad extension beyond Redding (Cal.) are slaughtering hundreds of snakes that have taken up their quarters there. Every blast of powder sends into the air a writhing mass of snake flesh and the noise made by the rattlesnakes can be plainly heard at a distance.

MR. CHARLES S. PARNELL AS A STONE CONTRACTOR.—At a recent meeting of the Dublin Corporation an application was made by Mr. Parnell's agent to supply paving stones. A satisfactory report was given by the deputy surveyor, and it was resolved to give a small order on trial of 100 tons at £14 per ton.

THE DUTCH GAP CANAL.—Contractor Jule will use at the South Mill Pond 8,000 tons of stone and 110,000 ft. of plank for the bottom. The tide is expected to fill the canal from 4 to 7 ft. deep and a current with a velocity of 5 to 6 miles an hour is expected to pass through.

THE PRELIMINARY arrangements for the Indiana State Sanitary Convention were lately made in Muskegon. It will be held on Aug 23 and 24.

THE OCEAN has so far encroached into the bank of the inlet at Barnegat City that six or eight feet of the foundation of the government light-house is exposed. Strong wooden bulkheads are to be erected.

THE EXECUTIVE COMMITTEE OF THE MISSISSIPPI VALLEY SANITARY COUNCIL lately met in Memphis. It was decided to maintain the inspection service by river and rail after 30th of June.

NEW ROADS.—It is expected that work on a new railroad between Mount Pleasant, Westmoreland County and Punxsutawney, Jefferson County, Pa., will be begun in a few weeks. The company has a capital stock of $700,000.

THE EVANSVILLE, WASHINGTON & BRAZIL Railroad has been incorporated at Indianapolis. The capital is $1,000,000. The line will be 65 miles in length. Some doubts as to the genuiness of the scheme have been expressed.

A NEW RAILROAD FOR MAINE.—At a second railroad rally held at New Portland, Me., a few days since, an organization for building the proposed road from Farmington via New Vineyard to New Portland and Kingfield was affected. The Directors are now soliciting funds and pushing the work as fast as possible. The distance is 18 miles. The road is to be called the Farmington and Carrabsett Railroad.

THE BOSTON WATER BOARD is besieged with applications for the positions that are to be filled. Rumor has it that Mr. Dennis B. Cashman of the Boston *Pilot* is to succeed Mr. E. R. Jones as superintendent of the eastern division, who has had charge of that part of the line for twenty-five years.

THE SALE OF THE HOOSAC TUNNEL is thus treated of by the Springfield *Republican*. "There are strong indications that Massachusetts is making up its mind to cut loose from its monstrous elephant, the Hoosac tunnel. This enterprise has cost the State in round numbers $20,000,000. At 5 per cent. interest, this represents an annual burden of $1,000,000 or one-half the State tax. But in fact a considerable portion of this expenditure has been paid out of current revenue, instead of by borrowing. About $14,000,000 was borrowed, on which the annual interest, amounting to more than $700,000, has to be met by taxation. If the State can recover $7,000,000 for the tunnel and State railroad, this sum can be added to the sinking fund,

and will soon enable the State to reduce the annual State tax. The Troy and Greenfield Railroad sinking fund amounts to $5,600,000; $7,000,000 added to that would nearly fill it up to the sum required to pay the debt at maturity.

"The sale of a great State railroad is, however, a delicate matter, legally and pecuniarily, and in its relation to other roads. The act should be well guarded so that the Commonwealth should not lay itself open to any liabilities on account of the change. Some of the railroads which have not found great profit in their tunnel connections may seek opportunities in a loosely drawn act to recover from the State the profits which they have sought for in vain in traffic. It is, moreover, a time of general depression of railroad properties, especially of those in the gristle. The New York and New England, out of which the State fortunately sold at 50, has been quoted at about two-thirds that figure for many weeks. The railroad committee have put up the price from $4,000,000 to $7,000,000. The State will probably lose nothing by delaying till the next Legislature, while other 'syndicates' may be prepared to offer an advance of a few hundred thousand. The road will then be completed. It will be observed that the Fitchburg road, with its traditional shrewdness, did not encourage the scheme of sale till the last appropriation bill—that of $364,000 to complete the double track—had gone through. The State has waited for the Fitchburg road to buy for many years; now the road can afford to give the State six months in which to consider the terms of so important a sale. The State is not likely to lose anything by the delay, and may gain enough to pay the cost of a session of the Legislature. Nobody begrudges the Fitchburg road the possession of the tunnel, but when it is offered at considerably less than half the cost, at less than has been expended upon it by the State during the 10 years since the tunnel itself was pierced, the demand for delay and deliberation is not unreasonable."

NEW TELEPHONE COMPANIES.—A new company has been formed at Davenport, Iowa, to be known as the Iowa Union Telephone Company. The capital is $2,000,000. The Central Union Telephone Company, recently licensed under the laws of Illinois, and operating under the American Bell Telephone Company, of Boston, has purchased the property of the Midland, Western and Central Telephone Companies, embracing the States of Ohio, Indiana, and Illinois, and the principal towns of Iowa.

COAL DIGGING BY MACHINERY.—B. F. Asper, of Pittsburgh, and S. B. Benson, of Philadelphia, have just received a patent for a mechanical coal-digger, which they claim will do the work of thirty men, with one man to run the engine. Arrangements have been made to commence their manufacture in Baltimore next week. Among the stockholders are Senator Mahone, of Virginia, ex-Senator Blaine, and ex-Senator Davis of West Virginia.

THE MANUFACTURERS OF BARB WIRE met at Chicago on Thursday for the purpose of effecting some understanding in regard to reducing the royalty of the Washburn and Moen Company, of Worcester, Mass., who have control of all the patents. The company propose to reduce the amount of royalty about one-half, and as this is only a very slight advance on what the dealers say they are willing to pay, it is likely an agreement will be reached in a few days.

COMMODORE GARRISON'S GAS COMPANY.—One of the largest gas companies in Chicago is the Peoples', which illuminates the west side. The controlling interest is owned by Commodore C. K. Garrison, of New York. A special meeting of the company's stockholders was held on Wednesday, Commodore Garrison being represented by Samuel G. Wheeler, Jr., of New-York. The meeting was an interesting one, as there was a decided opposition by an active minority to all the action taken by persons representing a majority of the stockholders. President Billings, of the company, is a son-in-law of Mr. Garrison, and the minority stockholders are very much dissatisfied because there has been no dividend for years. They will probably ask for a receiver.

THE SUEZ CANAL.—At a meeting of British shipowners held on Thursday in London, opinions were received from eminent English counsel which were decidedly against Count de Lesseps' monopoly of the work of constructing canals across the Isthmus of Suez. A committee of the shipowners will forthwith demand power to construct a second canal.

DISCHARGE OF NAVAL CADETS.—An order has been issued from the Navy Department, detaching from the Naval Academy the class of Naval cadets and cadet engineers who completed their six years, course June 10, and ordering them to their homes. On the 1st of July twenty-three of this class will receive their commissions in the navy, and the rest will be honorably discharged from the service with one year's pay. When Congress convenes in December next, strong effort will be made by friends of those who are to be discharged to have them reinstated, on the ground that the act of August, 1882, was not intended to apply to those who had alearly completed their four years at the Naval Academy.

THE HOOSAC TUNNEL has formed a subject of discussion for some time in the Massachusetts Legislature. The earnings of the tunnel and the Troy and Greenfield railroad were $224.149 in 1882, but the net income has been very fluctuating.

THE CHICAGO MILWAUKEE & ST. PAUL railroad officials having finished their annual inspection of the road, have decided to fill the gap between Mitchell and Aberdeen, Dakota. Work will be begun at once, and the seventy-five miles completed this season. The road is already built north from Mitchell to Letcher, a distance of fifteen miles, and south from Aberdeen to Ashton. The route laid out lies six to ten miles west of Jim river, following its course closely. The talked-of plans of building to Bismarck and west of Aberdeen to the Missouri river, and west from Howard to the Missouri, and also rumored extensions in Wisconsin and Illinois, have not been decided on, and a prominent official thinks there may be no more construction work whatever this season.

A ROAD WITH MANY ALIASES.—The short railroad from Bucksport, Me., to Bangor has perhaps experienced more changes of name and gauge than any other road of its length and age. It was incorporated as the Penobscot and Union Railroad, but before its construction was completed its name was changed to the Bucksport and Bangor Railroad. When the company was reorganized by the bondholders the name of Eastern Maine Railway was given it, and by the recent lease to the Maine Central Railroad Company it is now designated as the Bucksport branch of that road.

THE NEW YORK & NEW ENGLAND RAILROAD CO. is laying its double tracks rapidly. Four construction trains were put on recently.

THE ONTARIO & PACIFIC.—A BIG NEW ROAD.—A special dispatch from Montreal, June 25 says: "The contract for another great railway enterprise was given out to-day to build a new line, called the Ontario & Pacific Railway, from Cornwall, on the bank of the St. Lawrence, to Sault Ste. Marie, to connect with the Northern Pacific Railway over the big bridge, a distance to the western terminus of seven hundred miles. It is claimed that this will make the most direct and shortest line to the West from the Atlantic seaboard, and will give the Northern Pacific advantage over both the Canadian Pacific and Grand Trunk from ocean to ocean. The Dominion government charter gives the company power to build a bridge over the St. Lawrence. The contract has been given to a Philadelphia house.

A BIG BLAST.—For three months past preparations had been making for a great powder blast in the granite quarries at Syenite, about a hundred miles down the Iron Mountain Railroad and immediately south of the St. Francis River. The blast took place one day last week, when four thousand pounds of powder were discharged and over fifty thousand tons of rock, by actual measurement, were lifted and turned over in masses convenient for cutting into pavement blocks, and some twenty or thirty thousand tons more moved,

THE ST. JOSEPH WATER-WORKS.—Mr. F. J. Smith writes to us: "Owing to the heavy rains during the last three weeks our 16 foot forcing main has been carried away—the bluffs sliding from the height of 150 feet. There was no water for six hours, as temporary repairs had to be made. The whole line will have to be relaid at a cost of $5,000. The second Worthington engine has been in successful operation during the last month.

THE OLCOTT FALLS DAM.—A subscriber writing to us from Hanover, N. H., says: "The logs have begun coming down the Connecticut, and ten millions are expected to pass before September. The Olcott Falls near here has been dammed by a 610 feet dam, 300 feet being a tangent to the remainder, which is the arc of a circle having 138 feet for a radius. The gates in the bulkhead are of the Manchester pattern, and will be operated by a turbine. The dam was severely tested when the ice broke, and 7 feet of ice and water poured over it. Work is being pushed forward on the canal."

THE CONTRACT FOR BUILDING WARREN BRIDGE (BOSTON) has been awarded to Young, Ryan & Hayes, whose bid was $229,807.46 for the bridge and $8,067.73 for the siphon. The estimate of the City Engineer of the cost of the bridge was about $232,000.

SILICA AND LIME-WATER.—M. Ed. Landrin recently brought before the notice of the French Academy of Sciences some experiments which he has made, proving that silica had the property of absorbing lime-water. Four varieties of silica were employed—hydraulic, gelatinous, Graham's soluble silica and hydrofluoric acid silica. The process consisted in placing 0.03 grammes of silica in 100 cubic centimetres of lime-water, which had been treated with dilute nitric acid, and after a given time separating the silica charged with lime, and estimating the quantity of lime absorbed. Hydraulic silica absorbs more slowly than Graham's soluble silicate, but the silica of hydrofluoric acid absorbs slowest of all. In all cases the final absorption or saturation is for one equivalent of silica from 36 to 38 of lime. The formula, $3SiO_4CaO$, which requires for 30 of silica 37.3 of lime, therefore expresses the limit toward which these puzzuolanic phenomena tend.

THEODOLITE WAS ONCE DEFINED as "a person who hates the gods."

THE NEW BRIDGE AT HOLYOKE (MASS.) will be of wrought iron, in two spans of 66 feet each, 60 feet wide over all. Bids will close on the 28th inst.

NEW HAVEN IS TO ISSUE SEWER BONDS for $50,000 for the construction of new sewers.

THE IRON AND METAL MARKET.

PHILADELPHIA, JUNE 28.

Inquiries for bridge iron for summer delivery have been presented in this market within a few days which will perhaps aggregate 4,000 or 5,000 tons. Competition is more active, and more contracts have been placed at very low prices. The usual quotations are unchanged, except that some angles are selling at 2.25c., and a slight reduction in channels and beams for large orders. The demand for plate iron is kept up, and there are inquiries in hand to-day for 1,000 or 1,500 tons, which will not be placed except at concessions from present asking prices. The downward tendency still exists, and hence it is that buyers are so solicitous for inside rates. A few important engineering works are contemplated, but iron will not be required for them for 90 days. The street car cable system will be adopted in this city. Inquiries for large lots have been made by ship builders. Nails continue in very active request. Small railway material is being delivered as fast as made. Offers are made at $37 for steel rails, winter delivery. Old rails still sell at $22. Forge iron is still weak at $17@$18.50 at furnace, and No. 2 is without sale. In foundry iron there is very little movement, and the stronger prices asked for No. 1 are not very readily paid, except for small lots. Asking prices, delivered, $20.50@$23.50, according to quality. Stocks in consumers' hands are low, and the declining output at furnaces makes it probable that better prices will be had at the opening of the fall trade. Restriction is being kept up, and supplies are being slowly depleted. Mills will shut down next week for repairs.

PITTSBURGH, JUNE 28.

The uncertainty as to the future course of iron is retarding demand and weakening prices. Last year, with the strike throughout the West, prices advanced very little, but with full production this year and greater capacity, there is a feeling among buyers that prices must decline to a point which will crowd some mills out. The selling price of refined iron is 1.90@2c. Nails are the most active on the list. Bridge and boiler plate are under fair demand, but the orders for future delivery will not carry mills over the summer. The statement of Graff, Bennett & Co. shows assets of $1,169,634, and liabilities $1,282,752. An agreement has been entered into by the creditors, which will permit the firm to continue in operation under trustees. The steel works are running two-thirds capacity. About 30 per cent. of the capacity of the iron mills will be idle during July. The Bessemer mills are loaded up with orders for summer and part of fall. Heavy shipments are being made by river and the inquiry coming to hand indicates an active demand, but at lower prices than those now ruling. The cable system will probably be introduced into our street-car roads.

Efforts are being made to secure the location here of the projected national foundry. The labor situation is without interest, and no recurrence of disputes is probable during the year.

ST. LOUIS, JUNE 28.

The iron trade in the West is duller than for several weeks, owing to the fact that the larger consumers anticipated requirements. Receipts of pig iron are falling off; receipts of nails are increasing. Demand for nails and small railway material is very active. Railway construction on short lines throughout the State is progressing favorably. The local mills are working mostly full time, but will stop two or three weeks during July. Inquiries for bar iron are falling off, and prices are not firm. Reports from the lead and zinc mines show an increase in production notwithstanding the fact that prices are weak. This is due, in part, to the increase of railway facilities, and to numerous investments made in mineral property. Traffic with the southwest is on the increase, and a large amount of bridge work is looked for as soon as construction on certain lines in Texas has reached the proper stage. All the smaller machine shops and foundries are working to full capacity.